

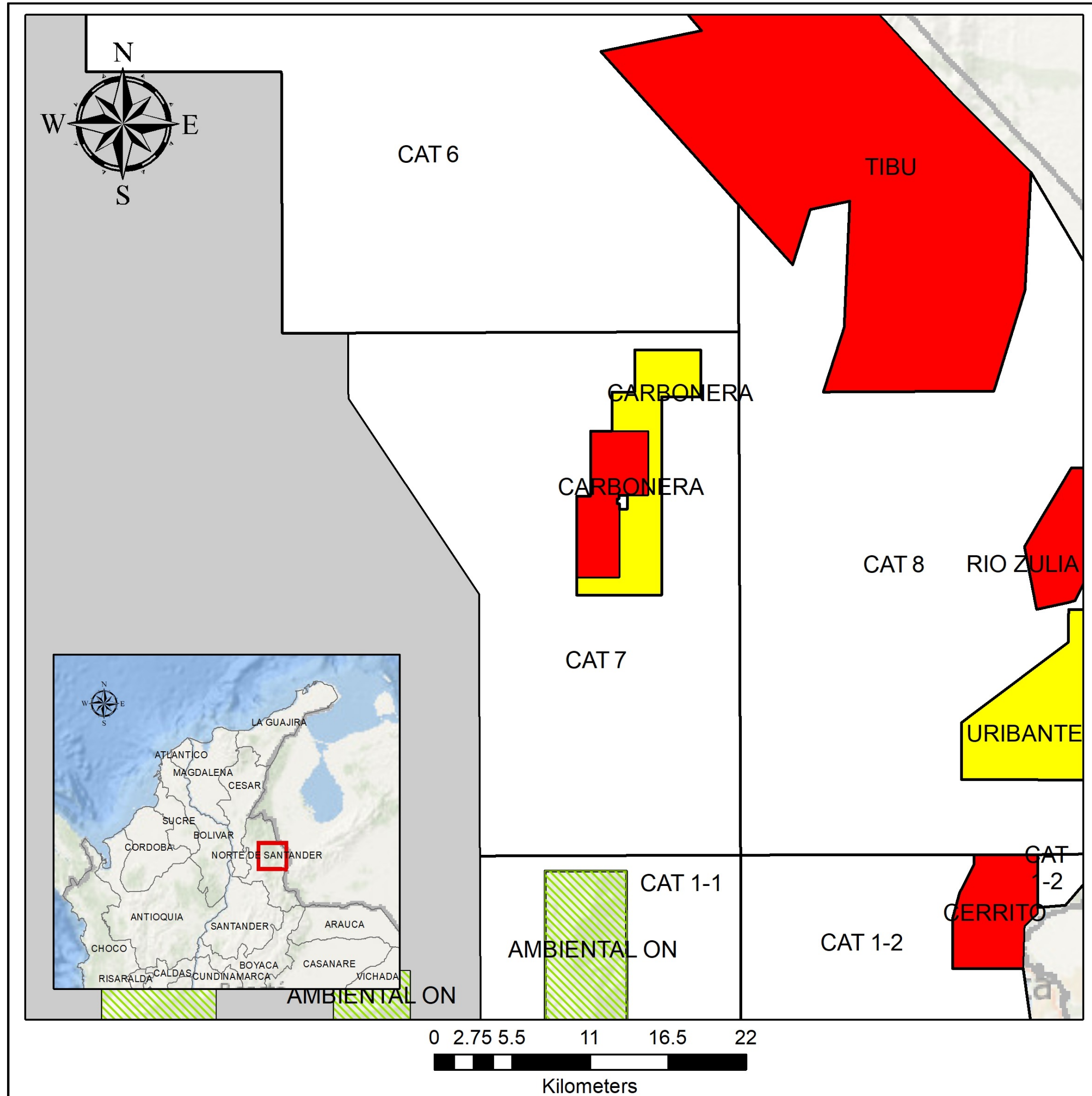
COLOMBIA 2022

SEISMIC PROGRAM ACQUIRED BY THE ANH: LAS MERCEDES-2019

Content

| | |
|---|---------------------------------|
|  | Location |
|  | Generalities |
|  | Las Mercedes 2D Seismic Program |
|  | Seismic Quality |
|  | Seismic Interpretation |
|  | Conclusions |

LOCATION



■ Block Areas

■ Cat 6 (135,369 Ha)

■ Cat 7 (78,326 Ha)

■ Cat 8 (101,029 Ha)

■ Carbonera (5,301 Ha)

■ Carbonera (3,555 Ha)

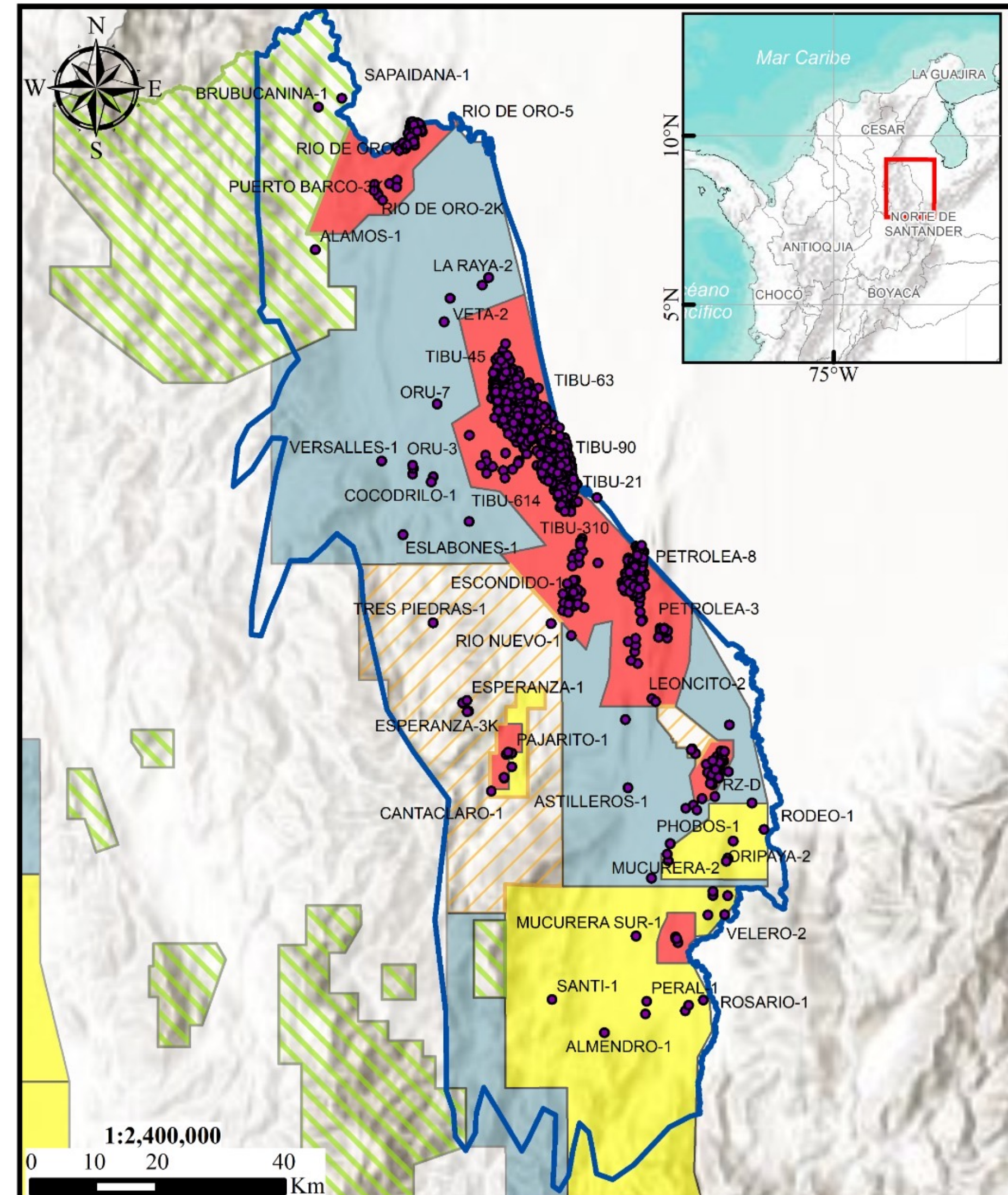
■ Department

■ Norte de Santander

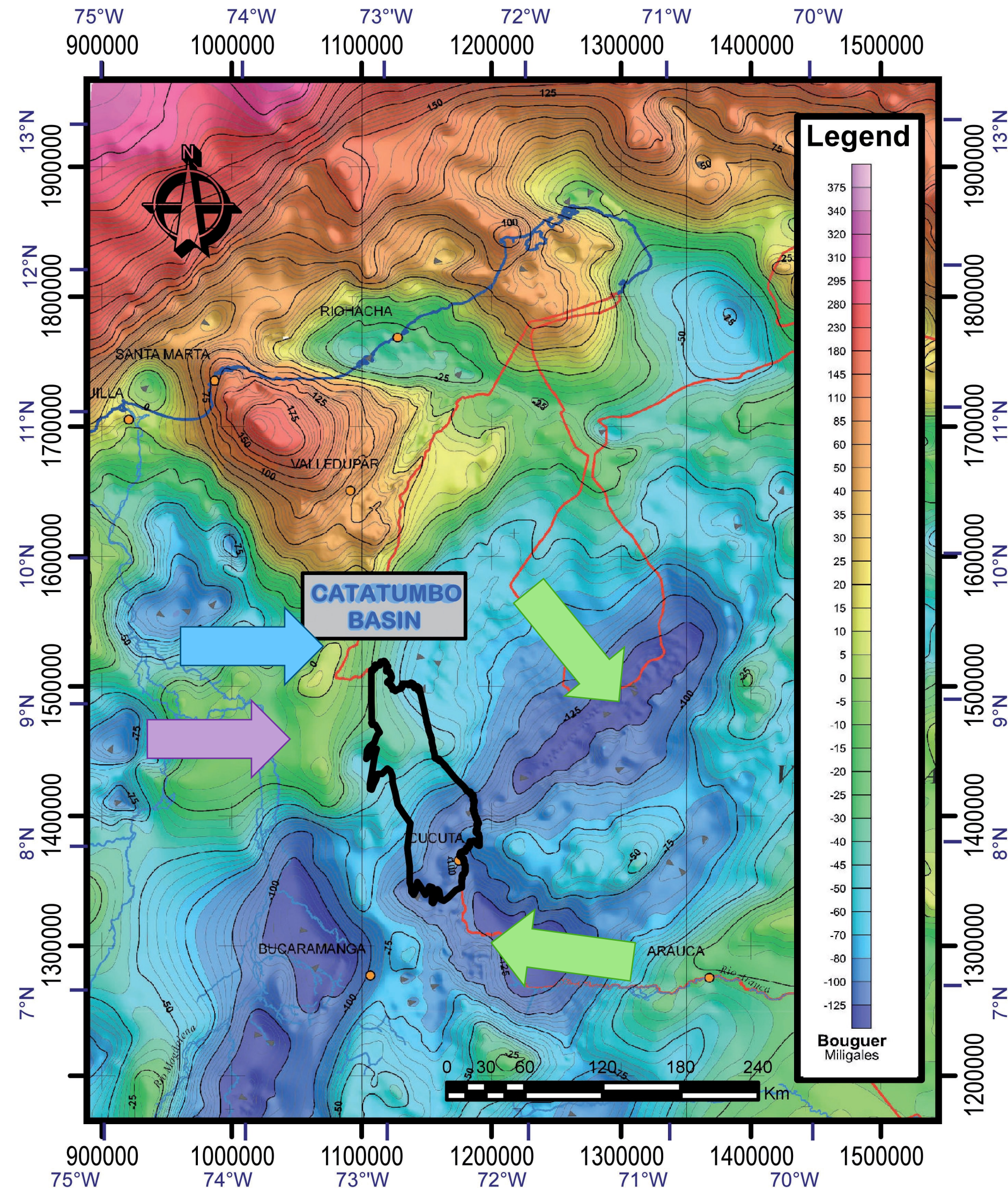
GENERALITIES

Catatumbo History of Exploration

- The Catatumbo basin shares with the middle Magdalena Basin the first commercial production in the country since 1920s
- A total of 872 wells have been drilled
- 3,874 Km of 2D seismic have been acquired
- 12 Oil & Gas have been discovered being the most important: Río de Oro, Tibú – Socuavo, Carbonera, Sardinata, Río Zulia, Petrólea and Puerto Barco
- The cumulative production of the Basin exceeds 450 MBP and 500 GPCG
- Its estimated exploratory potential varies between 1700 MBP and 200 MBP
- In order to reactivate the exploration in the area, the ANH acquired a 2D seismic program of 140 km into the area of the Esperanza wells



Bouguer Anomaly & General Structural Elements

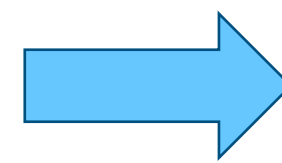


■ Main gravimetric features of the area

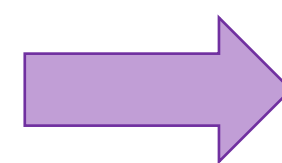


- **Main depocenters** (negative anomaly): It is an extension of the **Maracaibo basin!**

■ Eastern Boundaries

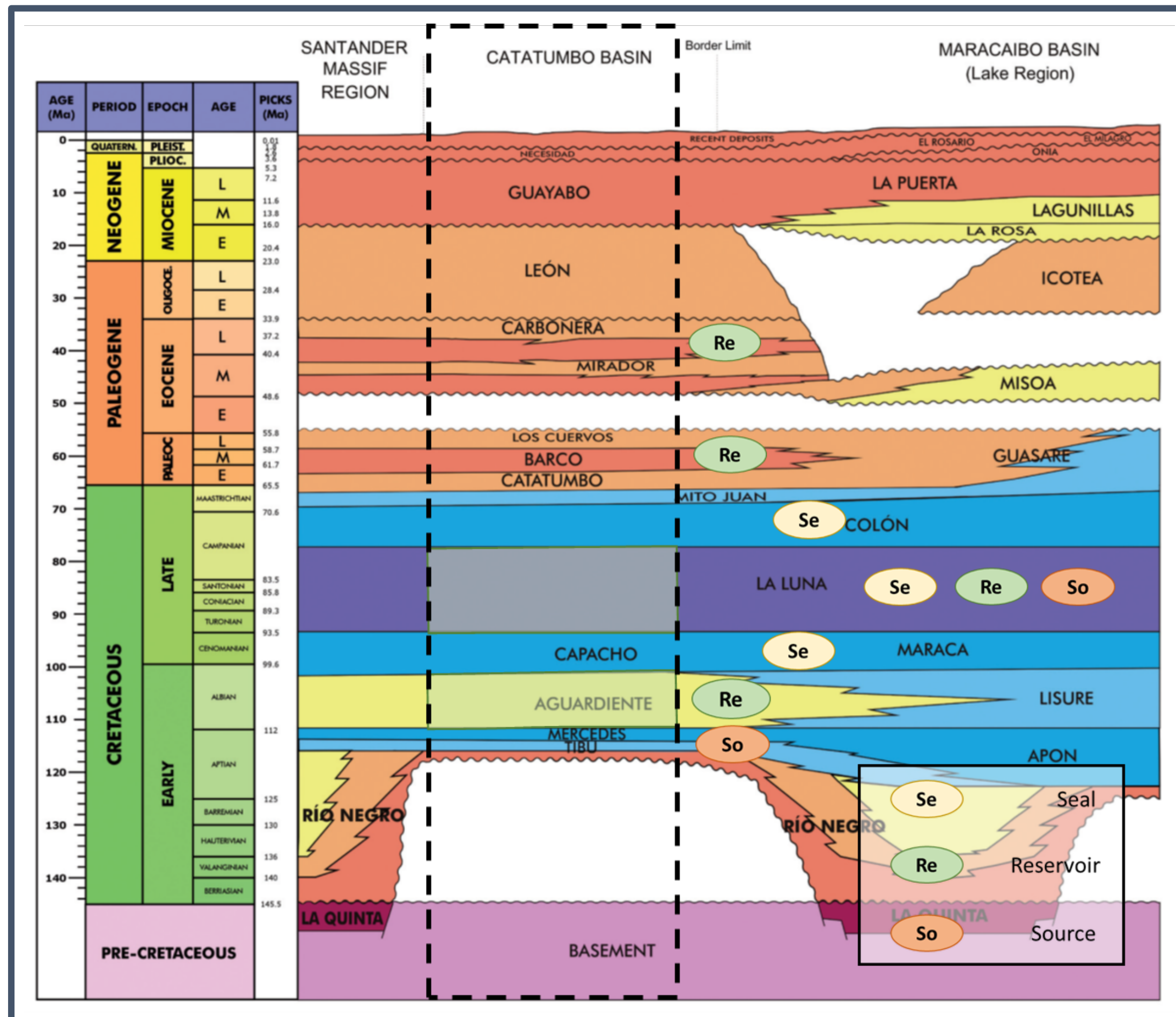


- Positive anomaly representing the **Serrania del Perija**



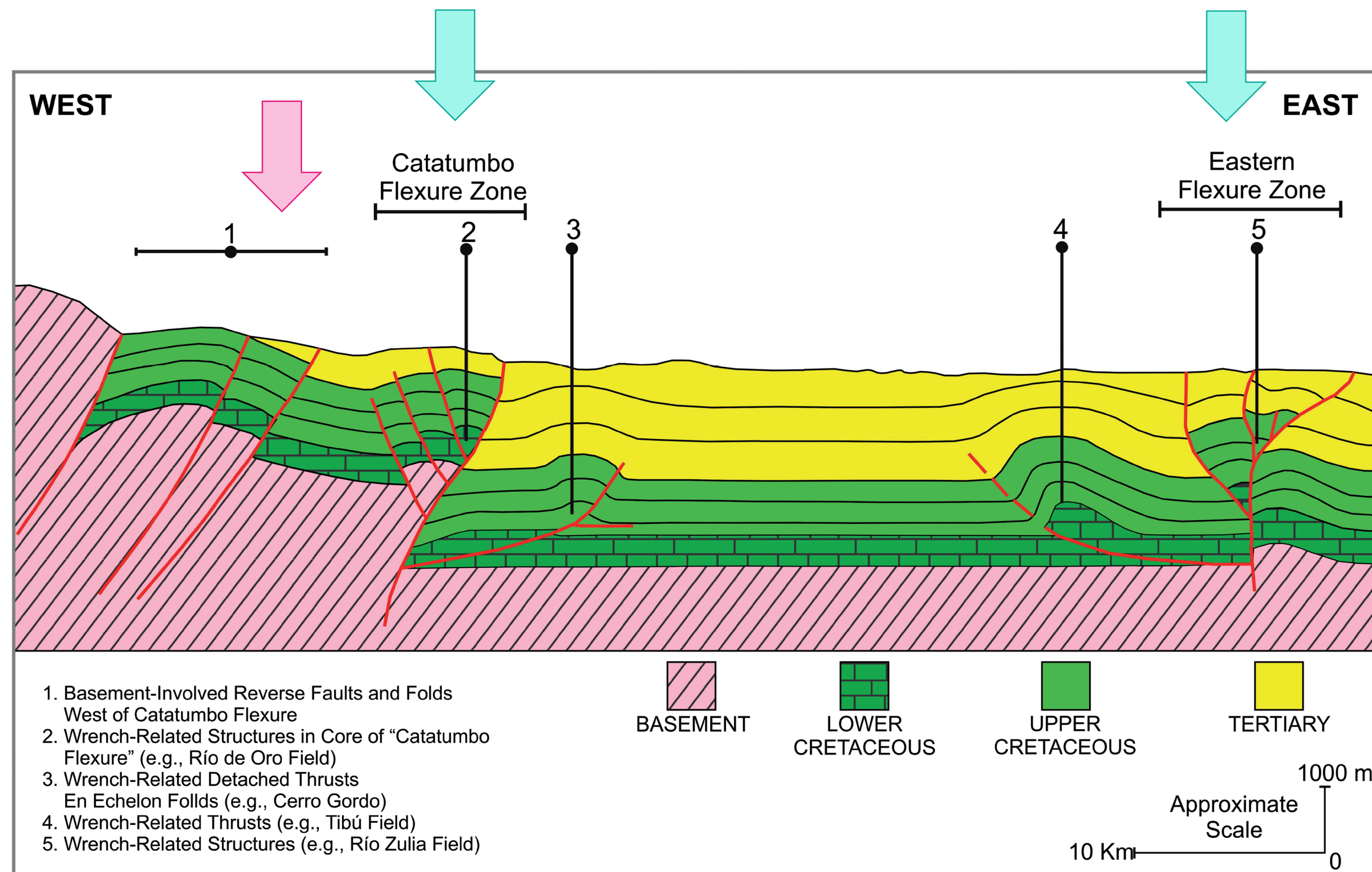
- Positive anomaly representing the **Santander Massif**

Stratigraphic Setting



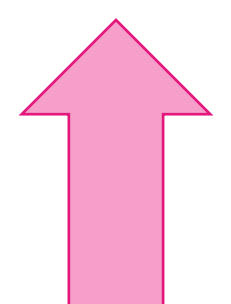
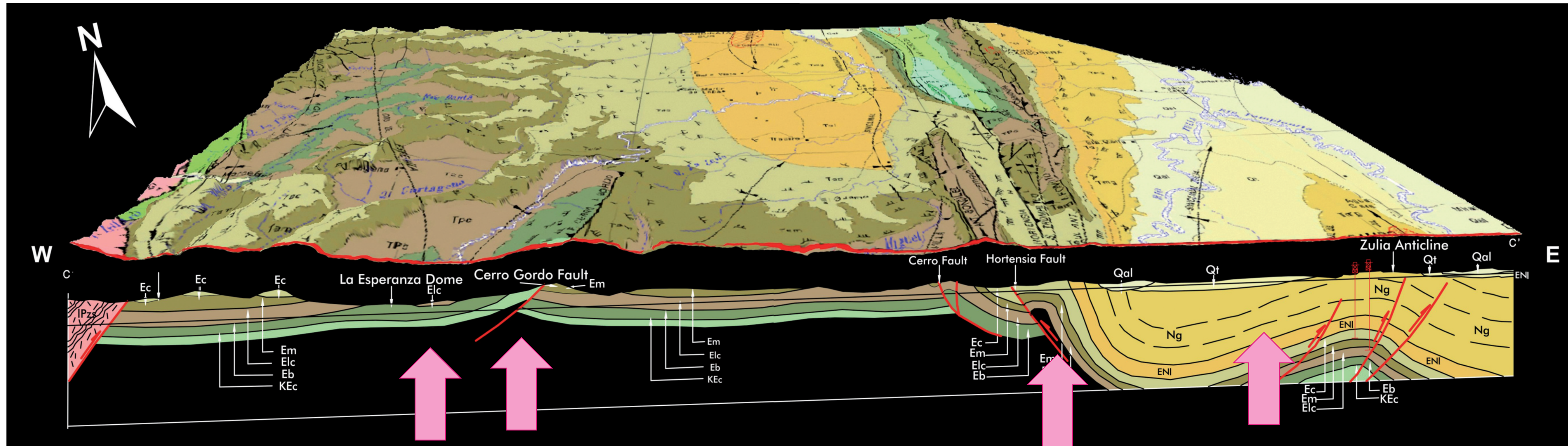
- **Carbonera, Mirador and Barco** have been identified as the main reservoirs in the Astilleros, Carbonera and Río Zulia West area
- **La Luna and Aguardiente Formations** have been identified as the main reservoirs in the Sardinata and Cerro Gordo area.
- **La Luna** acts as its own source and seal. The reservoirs as in Cerro Gordo field are associated to secondary porosities due to natural fracture of limestones.
- **Tibú and Mercedes** act as the source of the gas that could be present Aguardiente Formation
- The reservoirs of the Aguardiente Formation are mainly **shoreface sandstones** of high lateral continuity

Structural Framework



- **Two major styles have been proposed in the literatura**
- **1) One dominated by:**
- Reverse faults that affect the basement (thick skin)
- Folds that occurs on the Western Side.
- **2) A second one characterized by:**
- Thrust faults associated with wrenching
- Reverse faults and folds associated to bending in the western and eastern sides (flexure zone)
- Miocene to Pliocene age

Structural Setting: La Esperanza – Cerro Gordo – Rio Zulia



Opportunities identified by the ANH

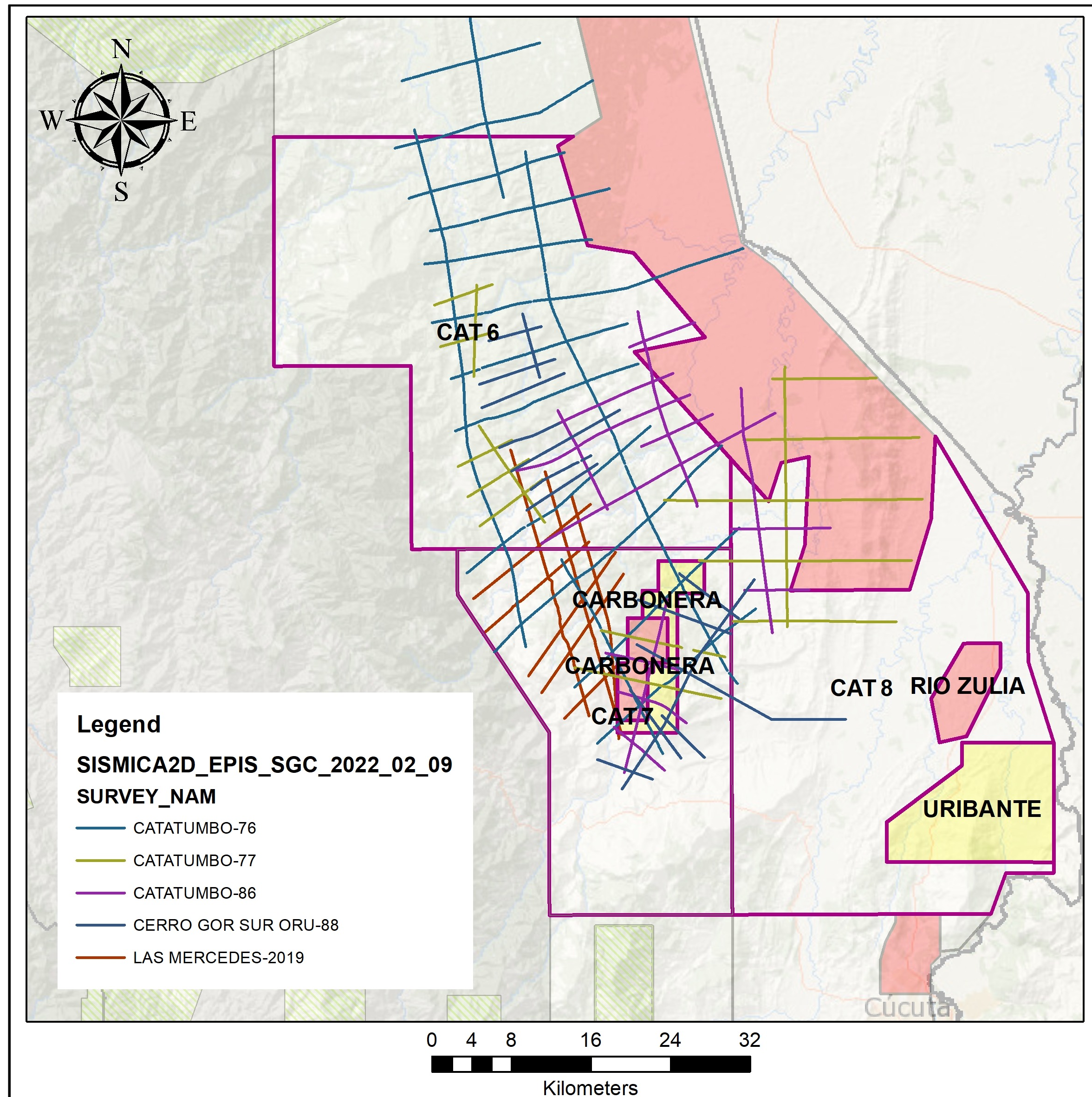
LEGEND

| | | | |
|------------|-----------------------|------------|-----------------------|
| Ng | Guayabo Group | Kco | León Formation |
| Enl | León Formation | Kl | La Luna Formation |
| Ec | Carbonera Formation | Kc | Capacho Formation |
| Em | Mirador Formation | Ka | Aguardiente Formation |
| Elc | Los Cuervos Formation | Km | Mercedes Formation |
| Eb | Barco Formation | Kt | Tibú Formation |
| KEc | Catatumbo Formation | Kr | Río Negro Formation |
| Kmj | Mito Juan Formation | Jlq | La Quinta Formation |

Producer Units by Field

| | Target Unit | Unit | Producer Field |
|--|-----------------------------|--|---|
| Main Targets | Channel Sands | Carbonera | Río Zulia Carbonera |
| | Channel and Shoreface Sands | Mirador | Río Zulia |
| | Channel Sands | Los Cuervos | Tibú Carbonera: La Silla Río Zulia |
| | Basal Sands | Barco | Sardinata |
| | | Catatumbo | Campo Yuca Carbonera Orú Río de Oro Sardinata Tibú |
| | Upper part Sands | Colón y Mito Juan | Río de Oro Oru Campo Yuca Carbonera: La Silla |
| | Calcareous units | La Luna | Tibú Petrolea Cerro Gordo Cerrito |
| | Platform Sandstones | Capacho - Cogollo | Pto Barco Tibú Sardinata Petrolea |
| Platform Sandstones and Calcareous Units | Uribante Group | Río de Oro Pto Barco Tibú Sardinata Petrolea | |

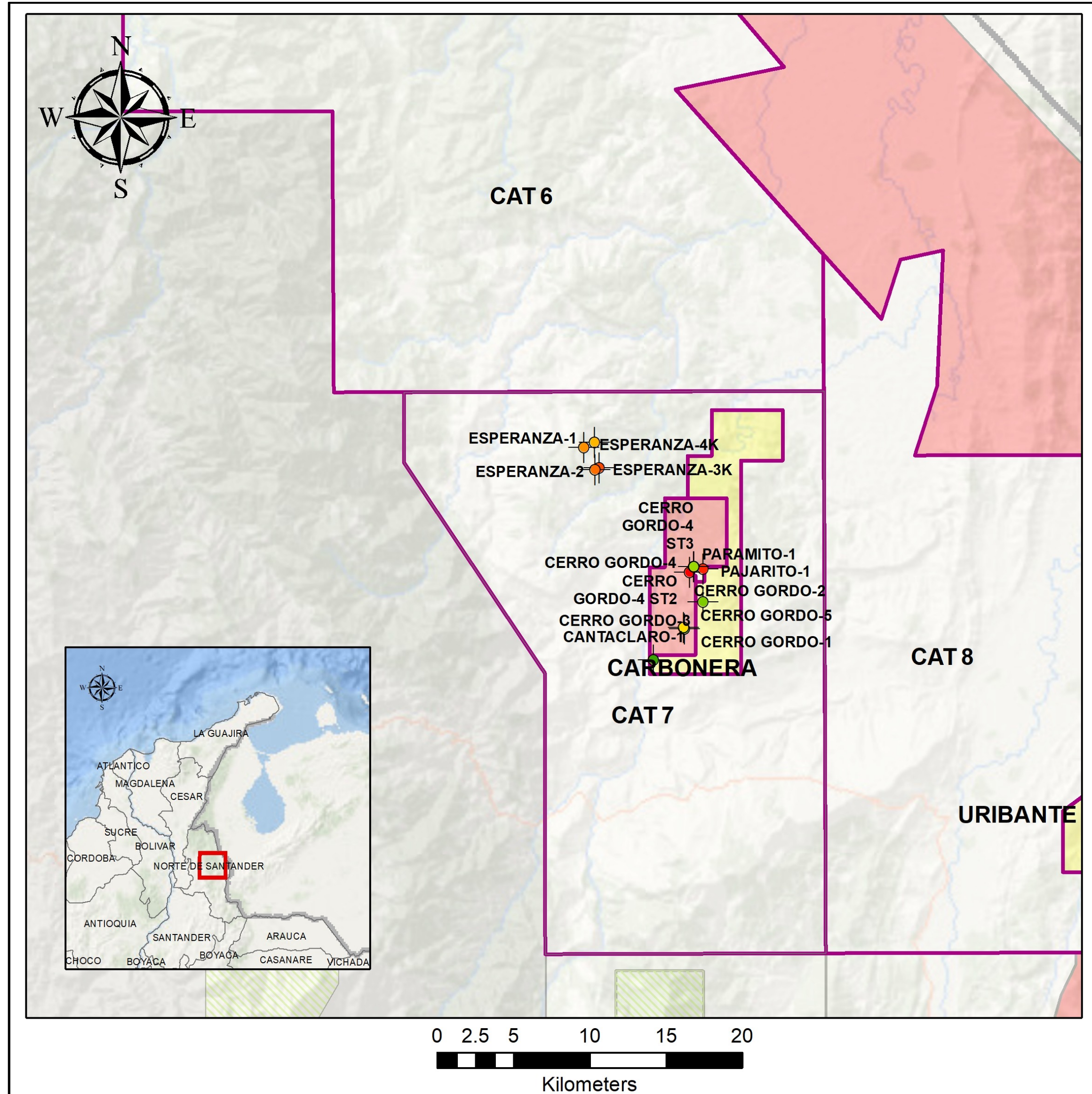
Units Present in Las Mercedes Area



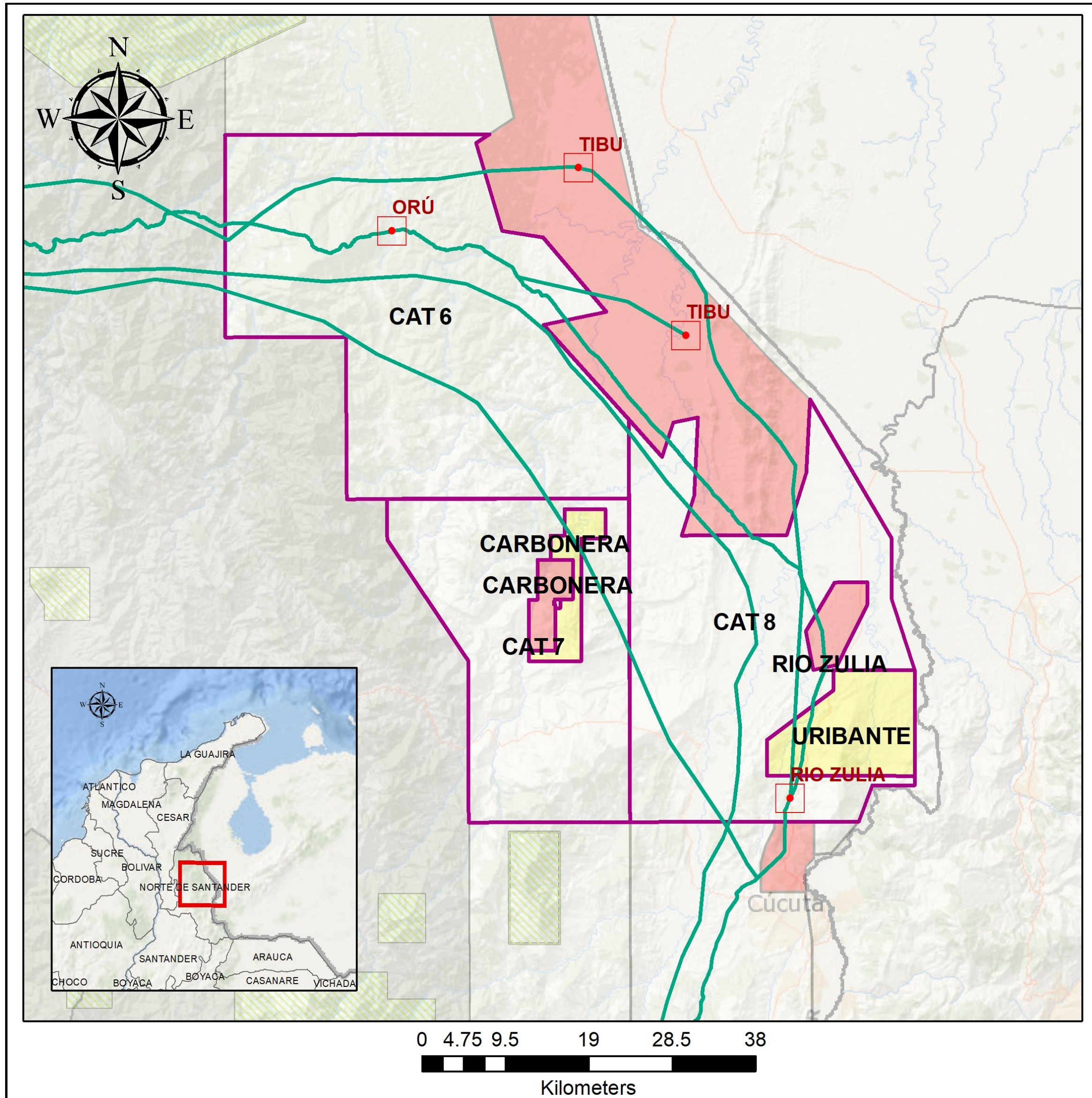
2D Seismic Surveys (4 Surveys)

- Catatumbo-76
- Catatumbo-77
- Catatumbo-86
- Las Mercedes-2019

Database: Wells



| WELL | YEAR | TD (ft) |
|-------------------|------|---------|
| PARAMITO-1 | 2009 | 6512 |
| CERRO GORDO-3 | 1989 | 6875 |
| PAJARITO-1 | 2010 | 2002 |
| CANTACLARO-1 | 2012 | 4071.96 |
| CERRO GORDO-4 ST3 | - | - |
| ESPERANZA-4K | 1979 | - |
| CERRO GORDO-4 ST1 | - | - |
| ESPERANZA-3K | 1981 | 5596.32 |
| CERRO GORDO-4 ST2 | - | - |
| CERRO GORDO-1 | 1987 | 2757 |
| CERRO GORDO-5 | 2013 | 3127 |
| ESPERANZA-2 | 1957 | 3155 |
| CERRO GORDO-2 | 1988 | 4410 |
| ESPERANZA-1 | 1956 | 0 |
| CERRO GORDO-4 | 1990 | 4960 |



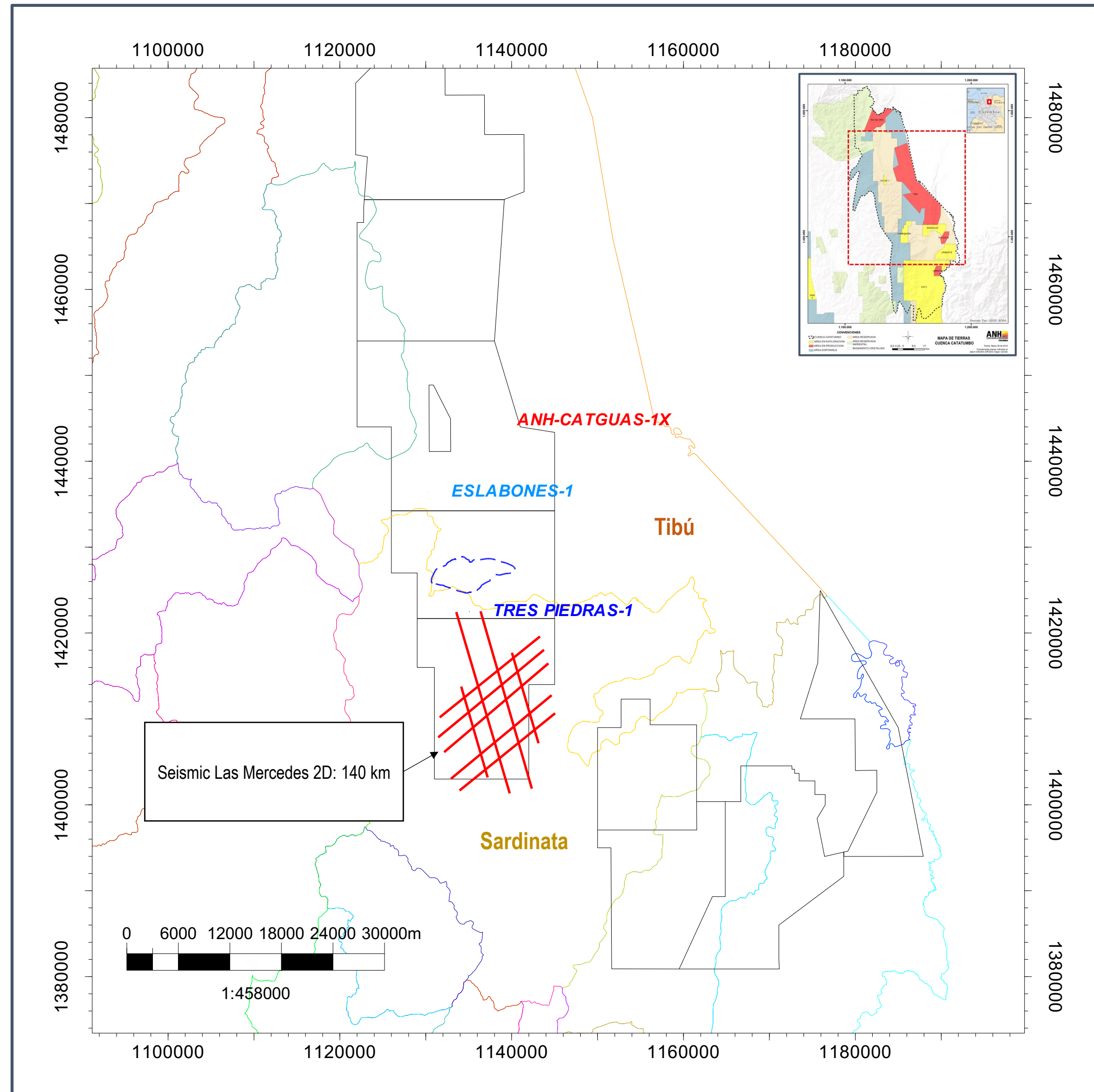
Main Infrastructure Nearby

Oil Pipeline

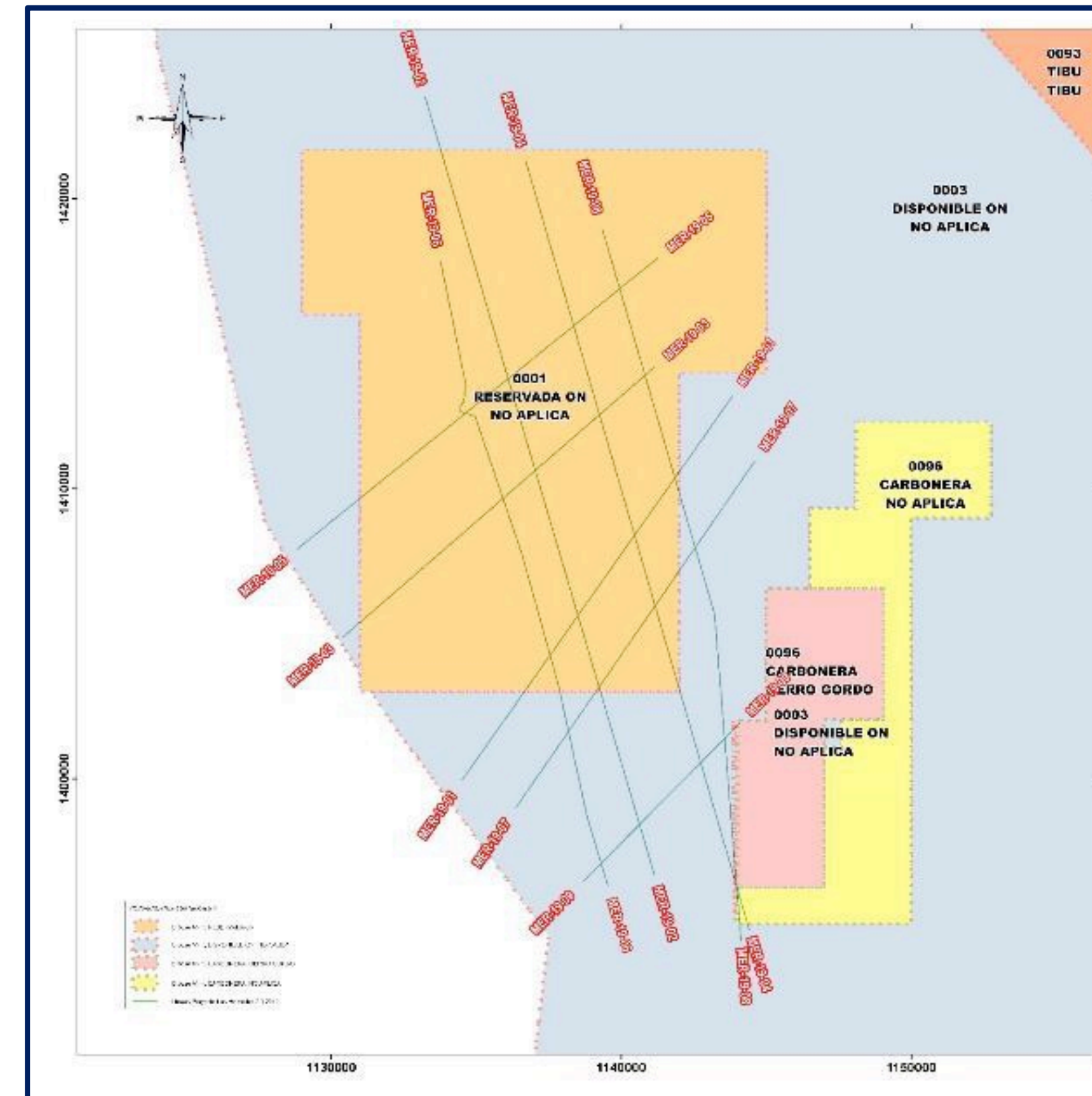
- Oru (Closest to CAT 17 *c.a.* 4.8 Km)
- Tibu (Closest to CAT 17 *c.a.* 5.5 Km)
- Tibu (Closest to CAT 17 *c.a.* 4 Km)
- Rio Zulia (Closest to CAT 17 *c.a.* 5.5 Km)

LAS MERCEDES 2D SEISMIC PROGRAM

Location: 140 km of 2D Seismic



Layout Proposed by ANH (140 Km)



Final Layout by Petroseis (137 Km)

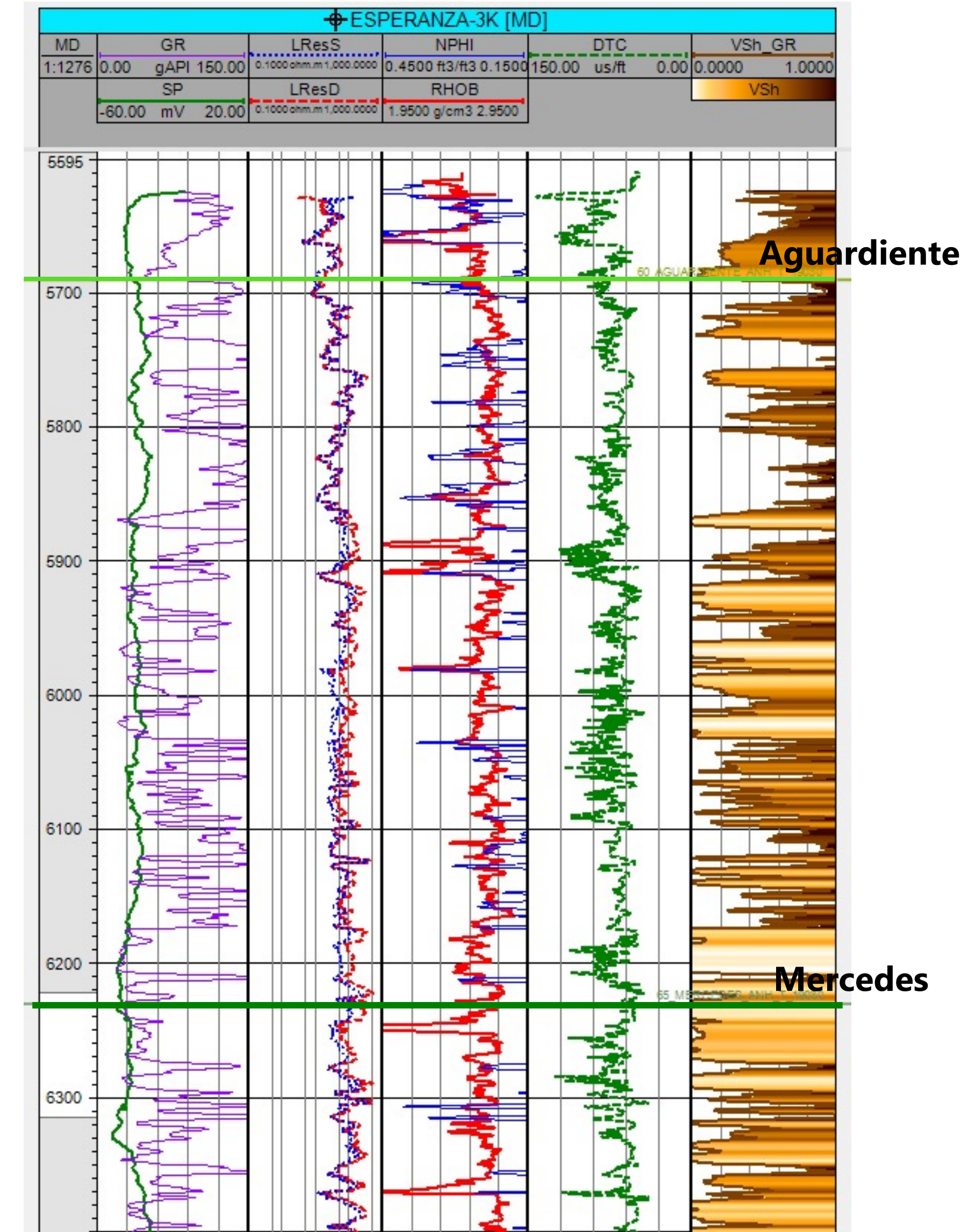
Esperanza Wells

Esperanza 3K (Representative Well)

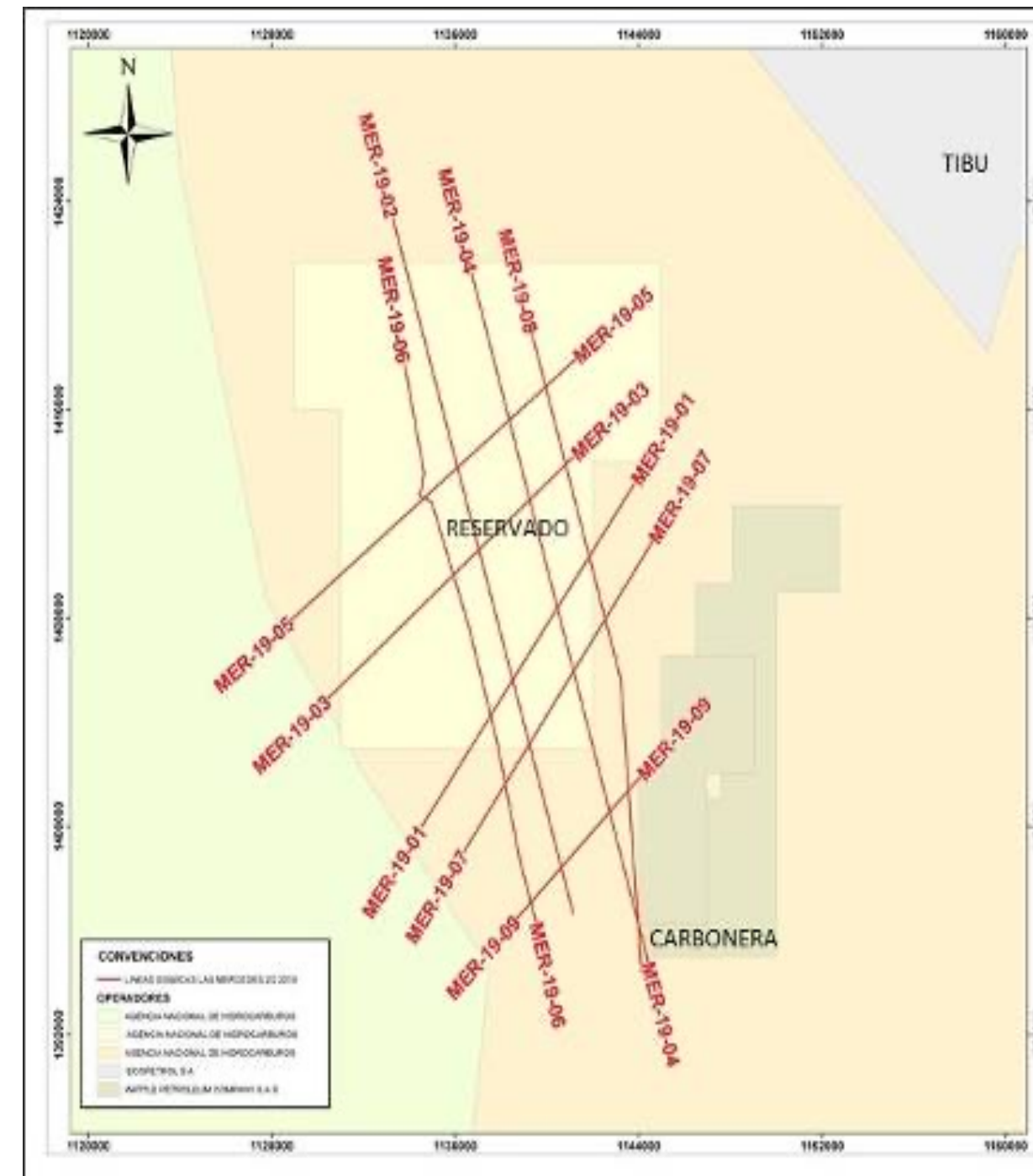
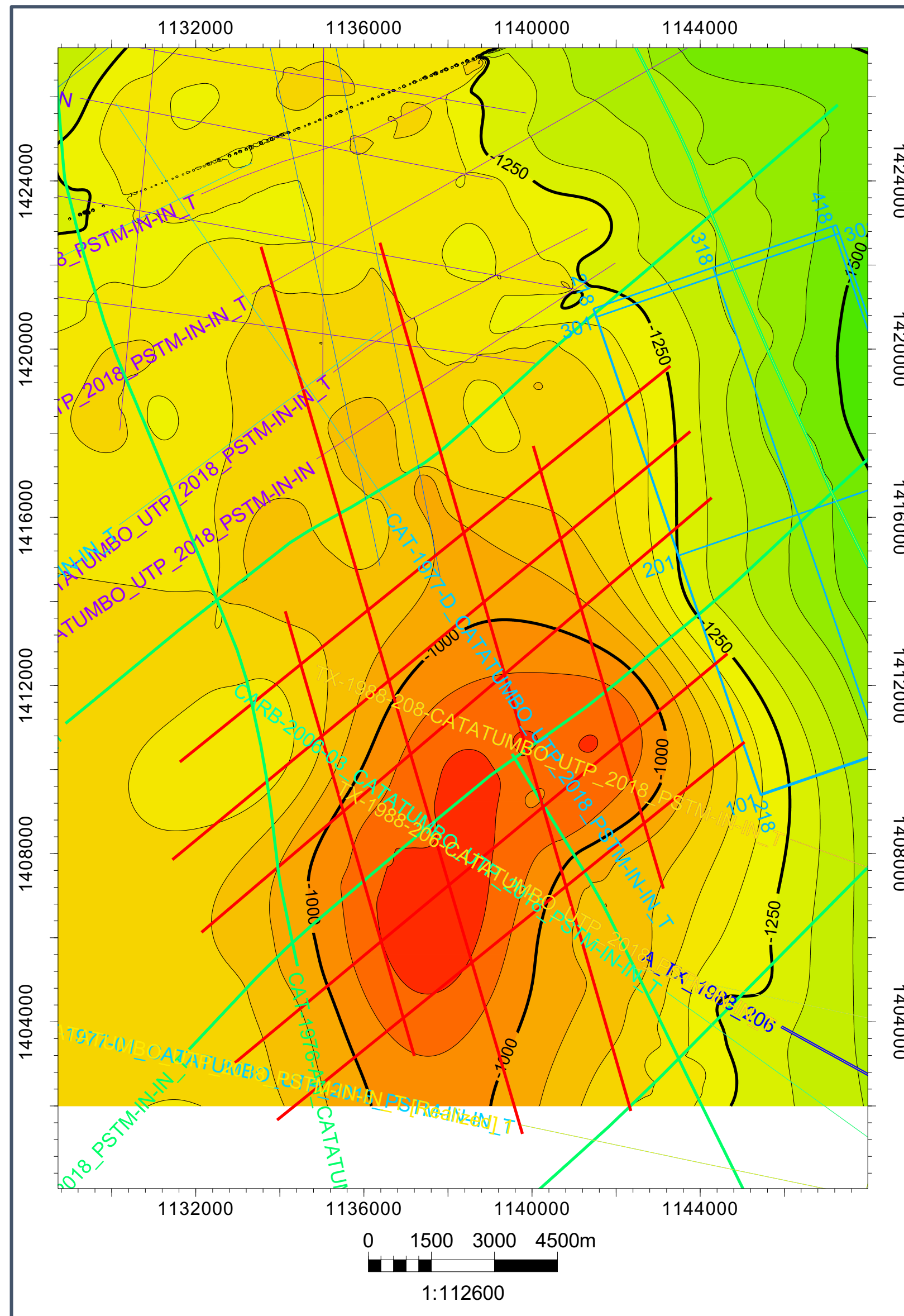
- Well drilled by Ecopetrol in 1981
- The well reached a total depth of **7,350'** passing through units of Lower Cretaceous and **Basement** including: Capacho, Aguardiente, and Tibú – Mercedes
- Target: **Uribante Group** (early Cretaceous) and the **Catatumbo Fm** (Eocene)
- Structure: Faulted anticline
- Two DSTs were taken:** DST1 and DST2 at Cogollo – Aguardiente Formations
- Non-commercial** quantities at the time of 900 KCFPD of CO2 in the **Aguardiente** formation were found
- The fault that gave the closure **WAS NOT FOUND**

| | |
|------------------------|----------------|
| Mirador | - |
| Los Cuervos | 170' (+2372') |
| Barco | 1130' (+1372') |
| Catatumbo | 1350' (+1192') |
| Mito Juan | 1820' (+722') |
| Colon | 3150' (-608') |
| La Luna | 4463' (-1921') |
| Cogollo | 4730' (-2188') |
| Uribante (Aguardiente) | 5690' (-3140') |
| (Mercedes) | 6230' (-3688') |
| (Tibú) | 6680' (-4130') |

Tabla 1. Marcadores Geológicos y Muestras de Hidrocarburo en el Pozo Esperanza – 3K



Las Mercedes 2D justification

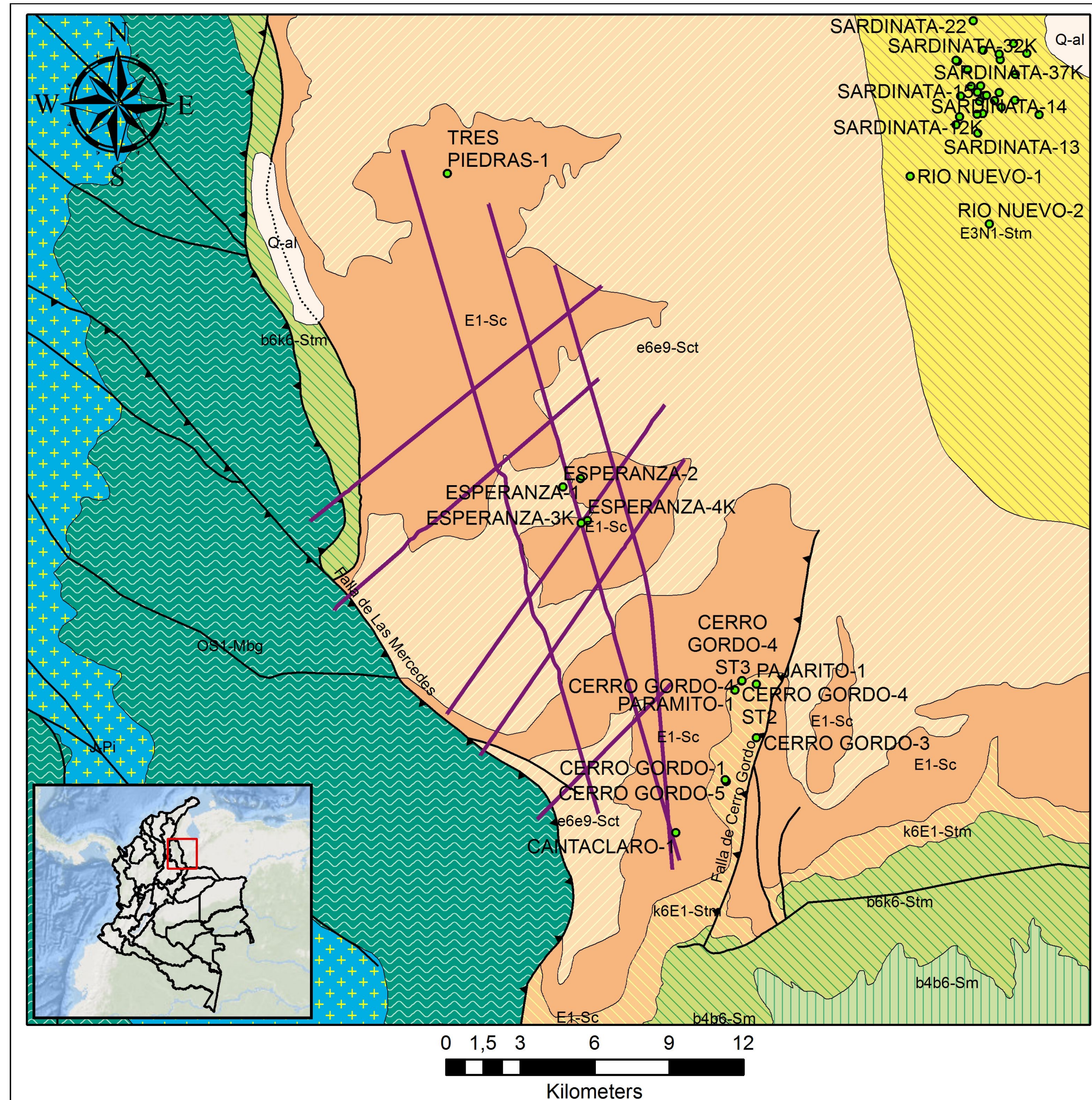


Justification

- A potential structure of 5065 acres could be mapped using two dip and two strike lines
- Las Mercedes 2D was acquired in order to prove its existence and geometry

Proposed Survey Geometry

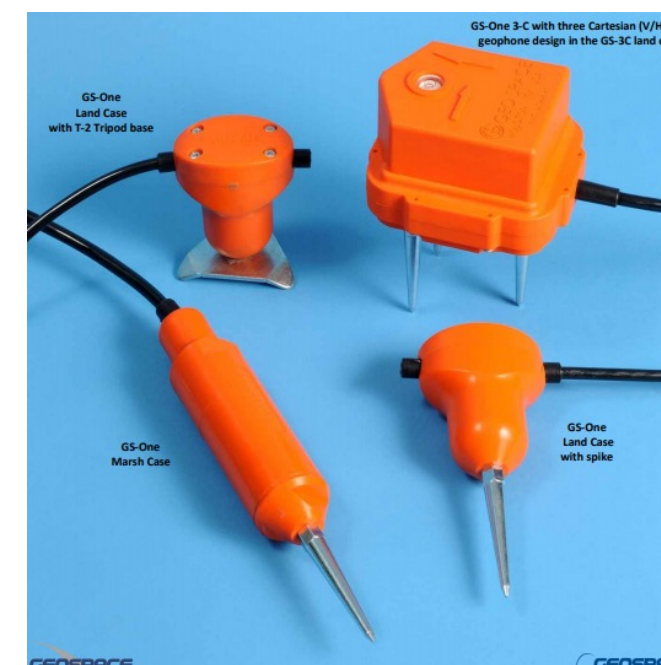
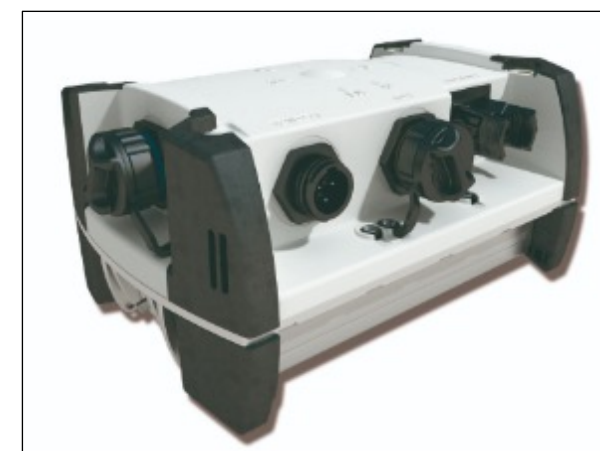
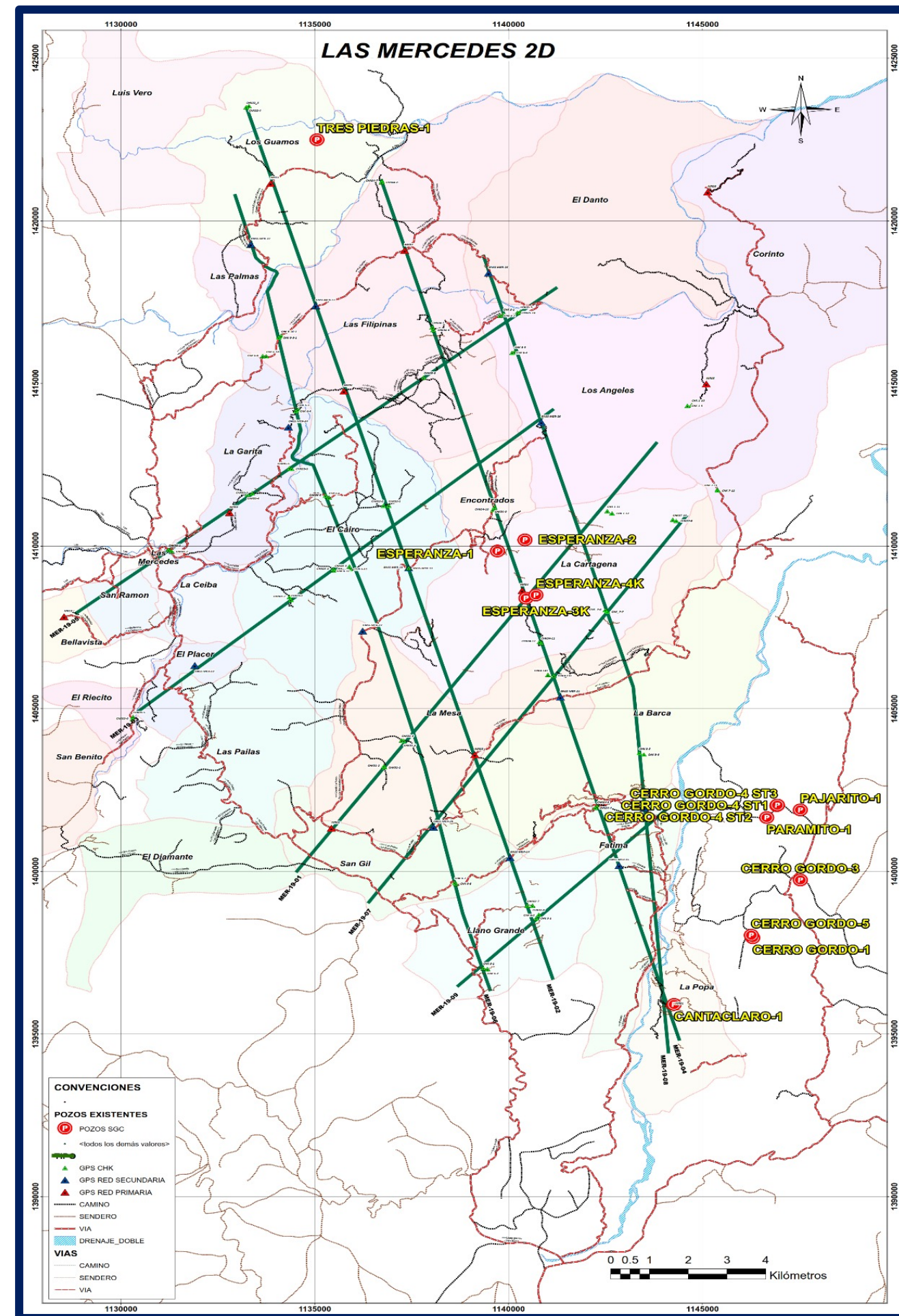
- Total Length Acquired: 171,5 Km
- Full Fold Length: 137 Km
- 5 Dip Lines (NW – SE)
- 5 Strike Lines (NE-SW)



Justification

- At surface, units such as **Carbonera**, **Mirador** and **Los Cuervos** are outcropping (no potential in these units)
- The surface geology shows a **giant monocline** dipping towards the northwest with **local folds** and **strike faults associated (mostly transpressive)**
- Two major faults limit the structure. At the west **Falla de Las Mercedes** and at the east **Falla de Aguardiente**.

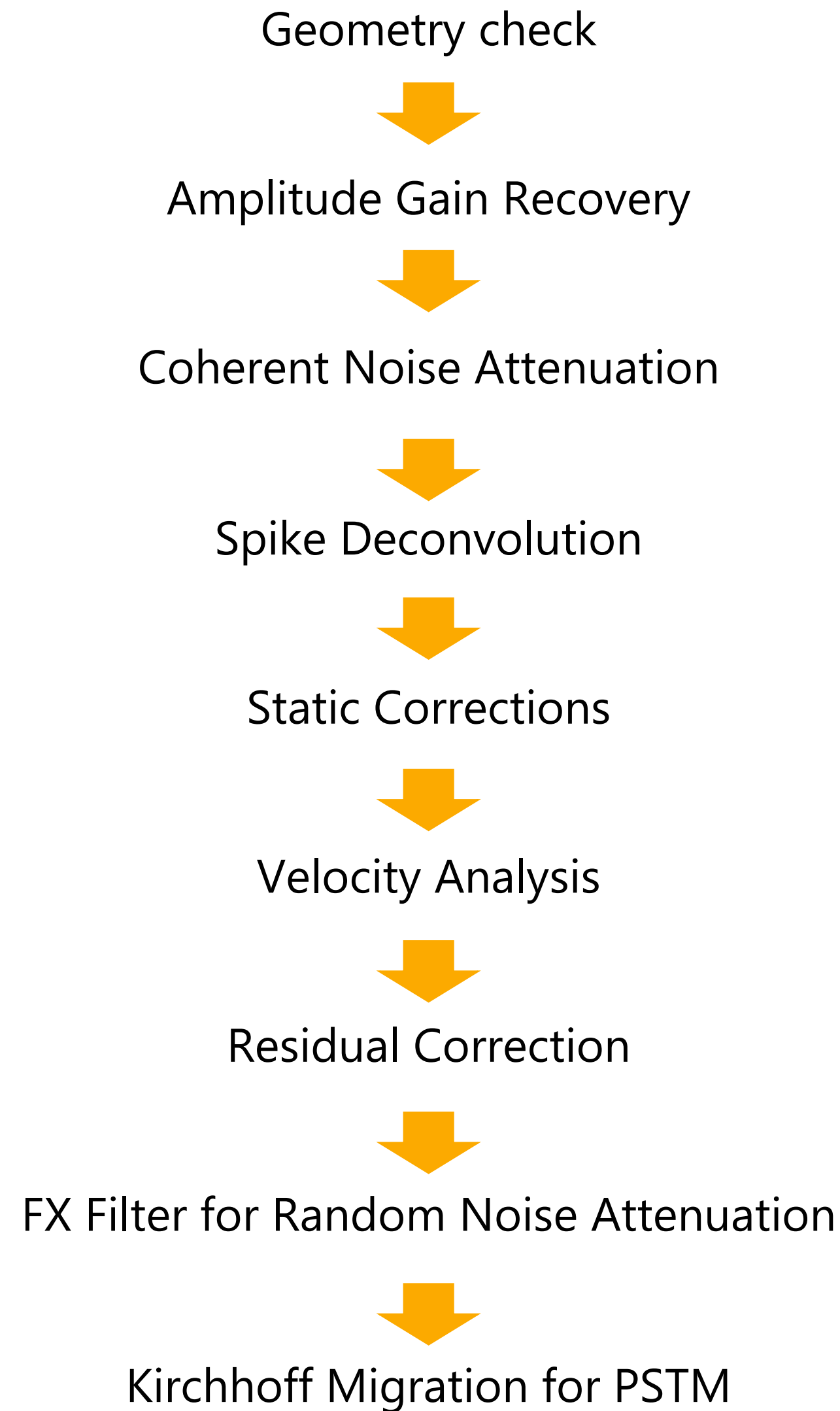
Las Mercedes 2D Acquisition Parameters



Parameters

- Shot Point Distance: 40m
- Receiver Point Distance: 20m
- Receivers: Geospace GsOne & Sercel 508XT
- Wells Depth: 9m (28')
- Explosive weight: 3,600g
- Number of active channels per split-spread: 360 & 400
- Length of register: 6,100ms
- Total of Wells: 4,159

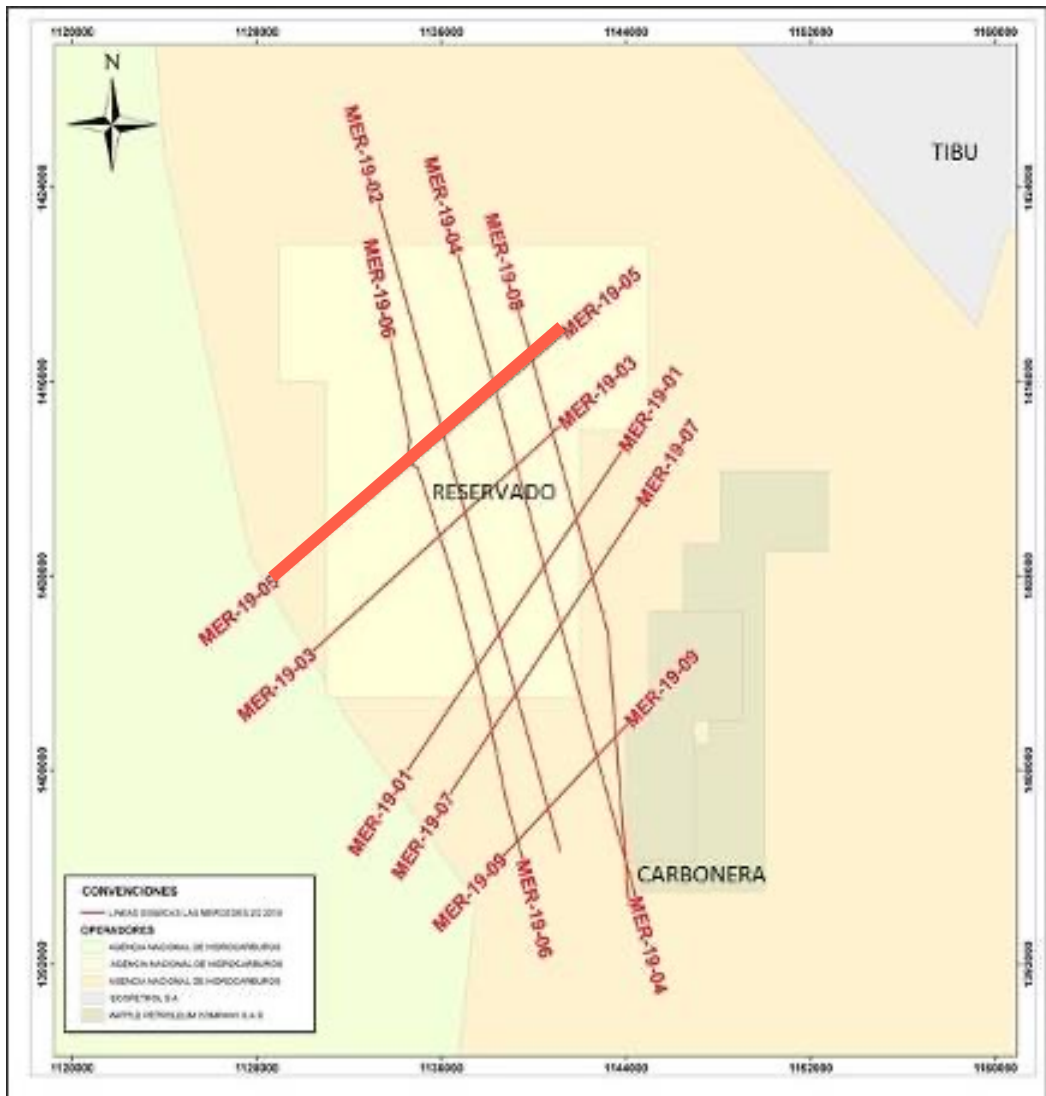
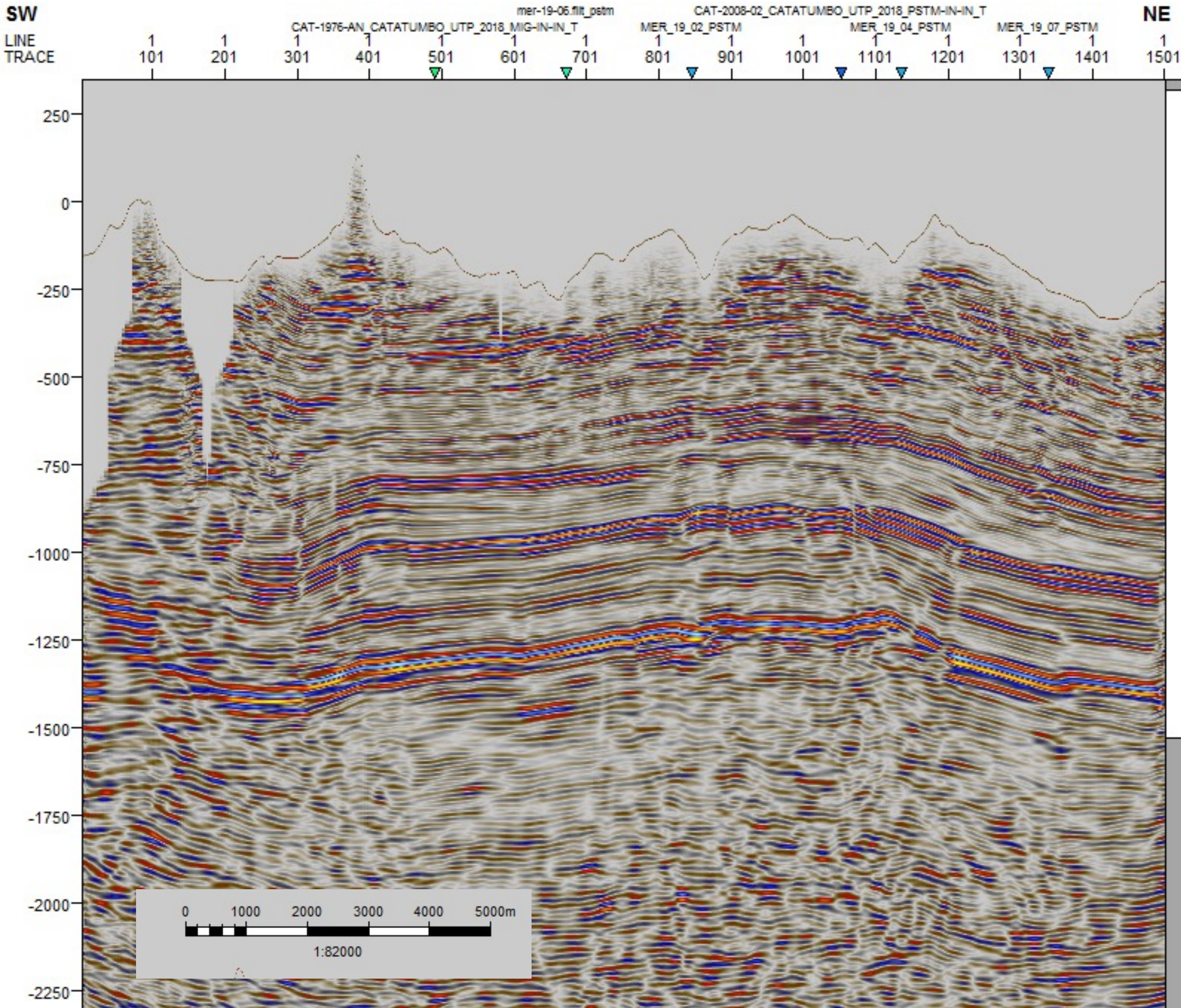
Las Mercedes 2D Processing Sequence



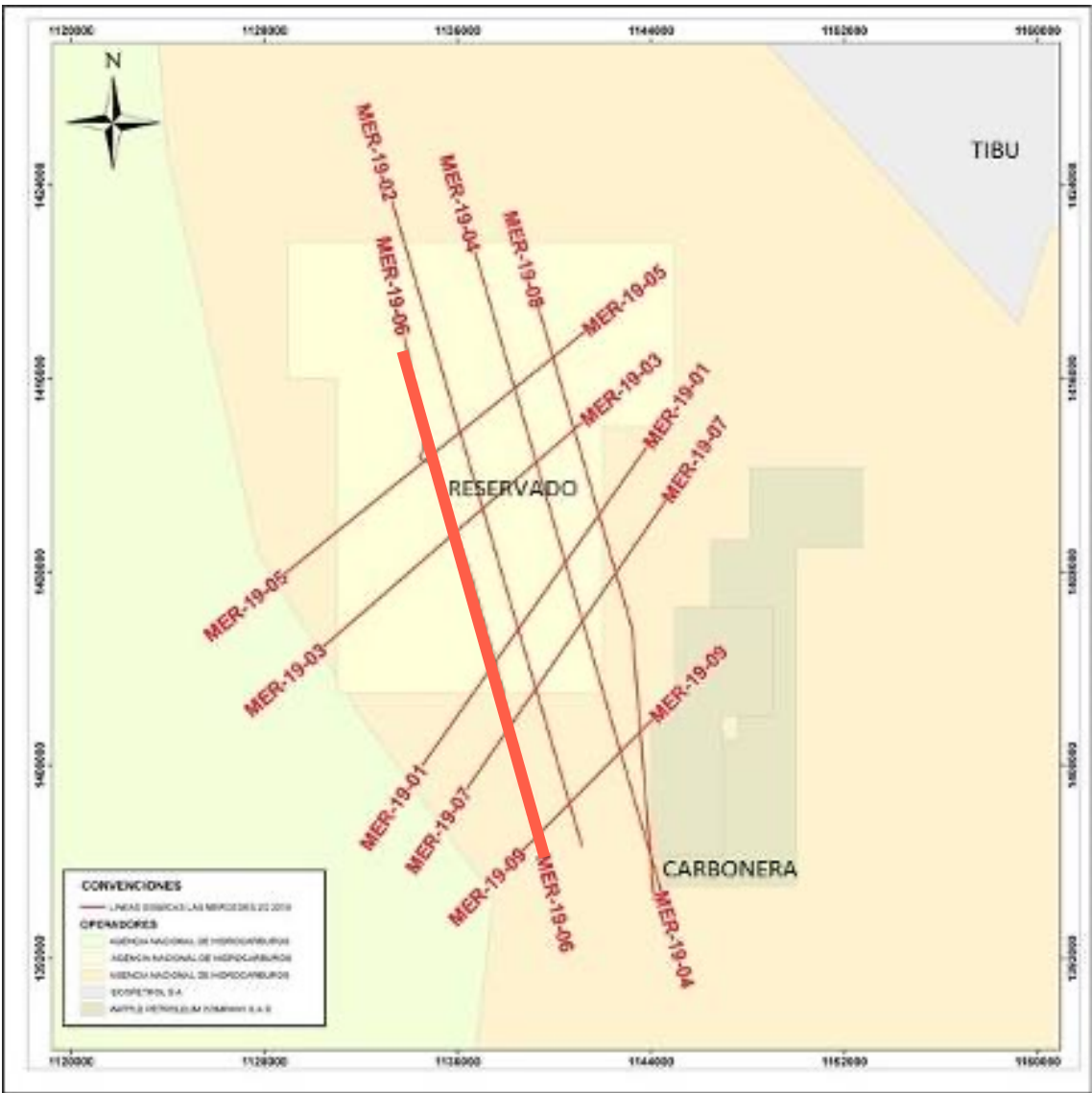
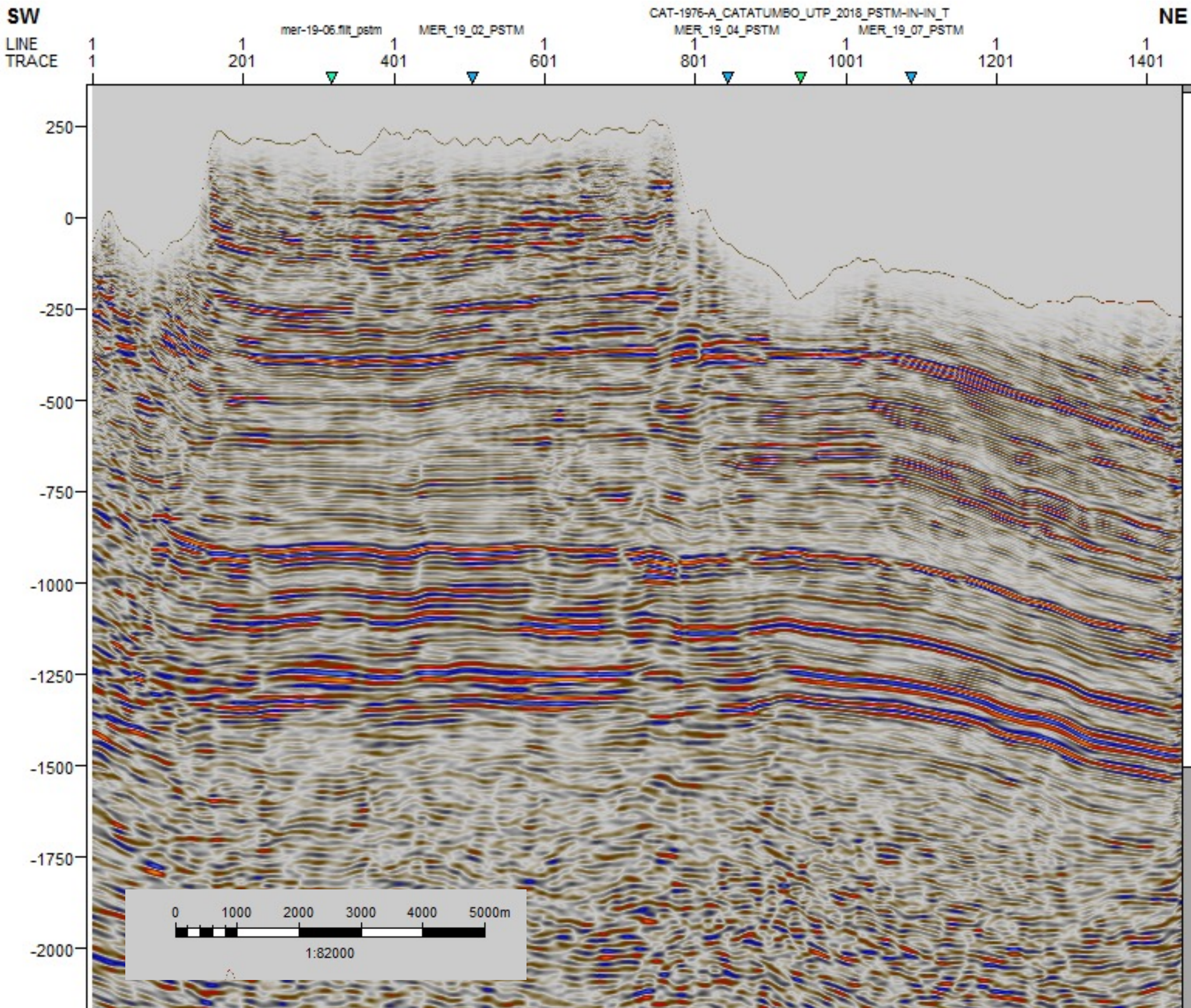
```
C 1 CLIENT: ANH                PROCESSED BY: Z-TERRA NORTH      2020 Nov 04
C 2 LINE: MER-19-01           AREA: LAS MERCEDES 2D 2019
C 3 REEL NO. mer01
C 4 SHOT BY: PETROSEISMIC SER. PARTY: 056 DATE: SEPTEMBER 2020
C 5 SHOT FOR: AHN              LOCATION: SARDINATA, COLOMBIA S.A.
C 6 NE                          SW
C 7 SP 1546                      SP 948
C 8 INTERVALS: SOURCE: 40 M RECEIVER: 20 M ACQUISITION FOLD: 100
C 9 SOURCE: DYNAMITE, 1 HOLE, 3.6 KG AT 9 M DEPTH
C10 RECEIVERS: GEOSPACE GS-ONE, 10 HZ, 70% DAMPING; SINGLE PHONE
C11 INSTRUMENTS: SERCEL 508 XT 400 TRACE
C12 TAPE FORMAT: SEG-D Version 3.0
C13 FIELD FILTERS: 0-200 .8NYQ MIN PHASE NOTCH: OUT
C14 SAMPLE RATE: 2 MS          RECORD LENGTH: 6.1 S
C15
C16
C17 POLARITY: SEG POLARITY STANDARD / POSITIVE STANDARD POLARITY
C18 REFRACTION SOLUTION: TOMOGRAPHIC, DATUM = 1200M, REPLACE. VEL. = 2900 M/S
C19 WEATHERING VEL 900 M/SEC PROJECTION ZONE: MAGNA-SIRGAS/MAGNA BOGOTA ZONE
C20 GEODETIC DATUM, SPHEROID GRS80 WGS84
C21 REFORMAT / GEOMETRY / GAIN RECOVERY
C22 SURF.CONSISTENT SCAL. PASS #1 SHOT/RCVR: 300-3500 AT 0M, 1800-3700 AT 4000M
C23 ANOMALOUS AMPLITUDE ATTENUATION PASS #1 - DESPIKE / COHERENT NOISE ATTEN.
C24 5-COMPONENT SURF.CONSIST.SIG. DCON: 300-3500 AT 0M, 1800-3700 AT 4000M
C25 SURF.CONSISTENT SCAL. PASS #2 SHOT/RCVR: 300-3500 AT 0M, 1800-3700 AT 4000M
C26 ANOMALOUS AMPLITUDE ATTENUATION PASS #2
C27 VELOCITY ANALYSIS PASS #1 / S.C. RESID. STATICS PASS #1
C28 VELOCITY ANALYSIS PASS #2 / S.C. RESID. STATICS PASS #2
C29 S.C. RANDOM NOISE ATTENUATION - FX4D / S.C. RESID. STATICS PASS #3
C30 PSTM VELOCITY ANALY. 2 PASS (KIRCH. PSTM) / REFINE VELOCITY AND MUTE PATTERN
C31 KIRCHHOFF PSTM / RNMO / STACK
C32 FX FILTER
C33 FILTER / SCALE
C34
C35
C36 TRACE HDR- BYTES 17-20,197-200: SURF.STN NEAREST BIN CENTRE (INTERPOLATED)
C37 BYTES 105-106: SMOOTHED SURFACE-IN-TIME (FLOATING DATUM)
C38 BYTES 109-110: TIME OF FIRST DATA SAMPLE (CONSTANT)
C39 BYTES 181-184, 185-188: BIN CENTRE X,Y COORDINATES
C40 BYTES 201-202: -1 * (MULTIPLIER APPLIED TO VALUES IN BYTES 17-20,197-200)
```

SEISMIC QUALITY

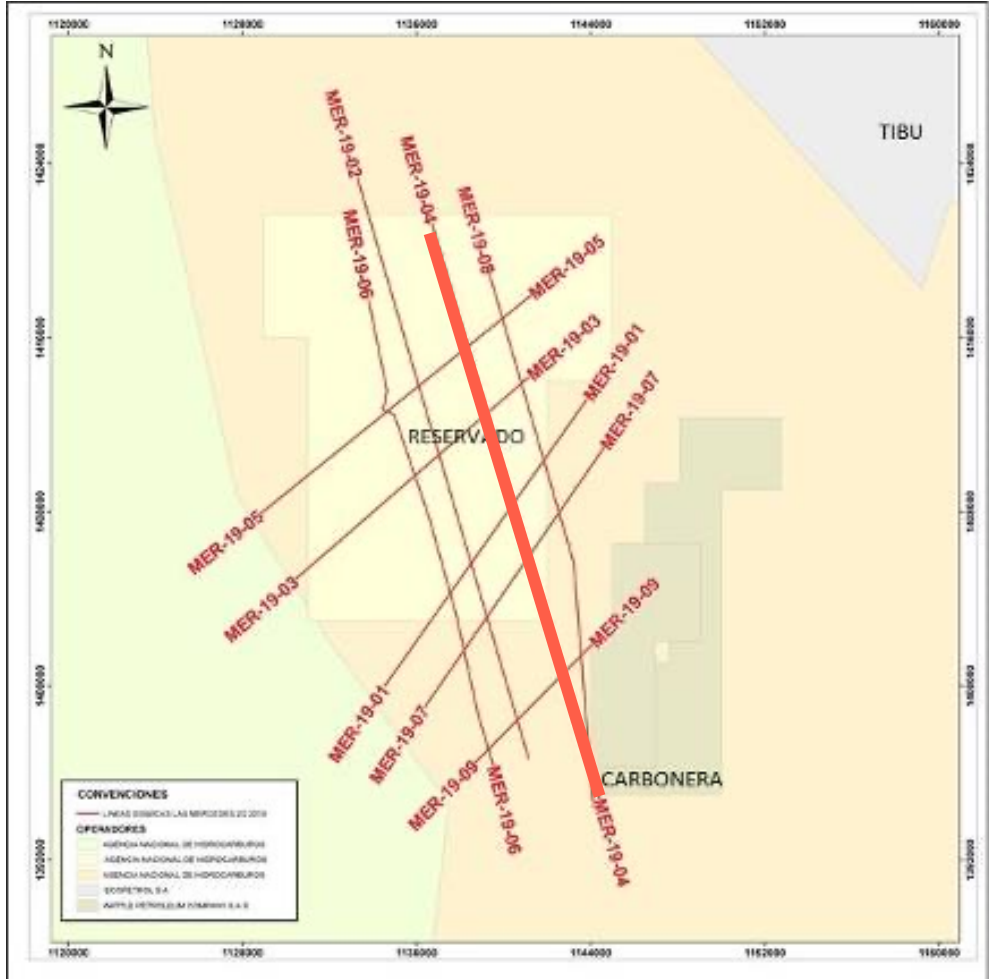
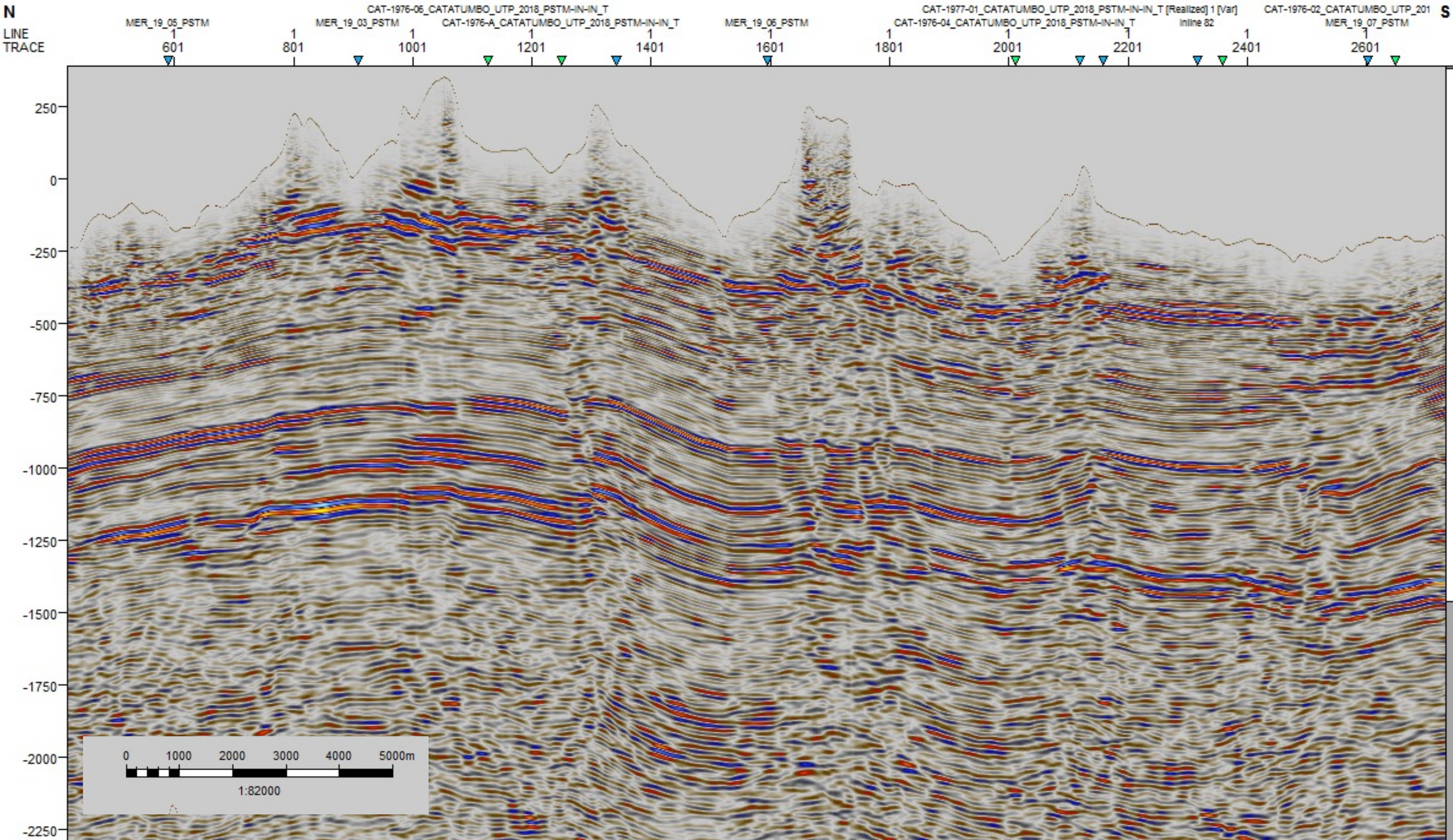
Seismic Lines: MER-19-05



Seismic Lines: MER-19-06

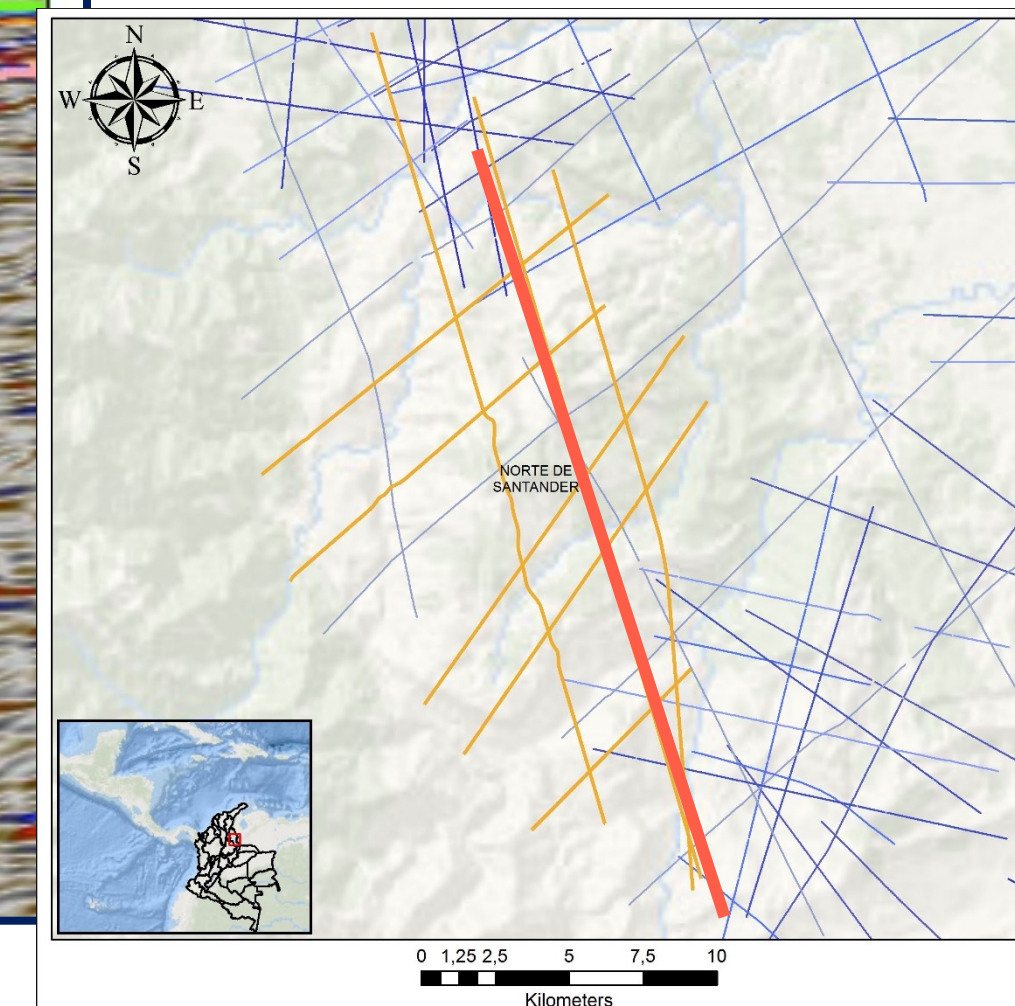
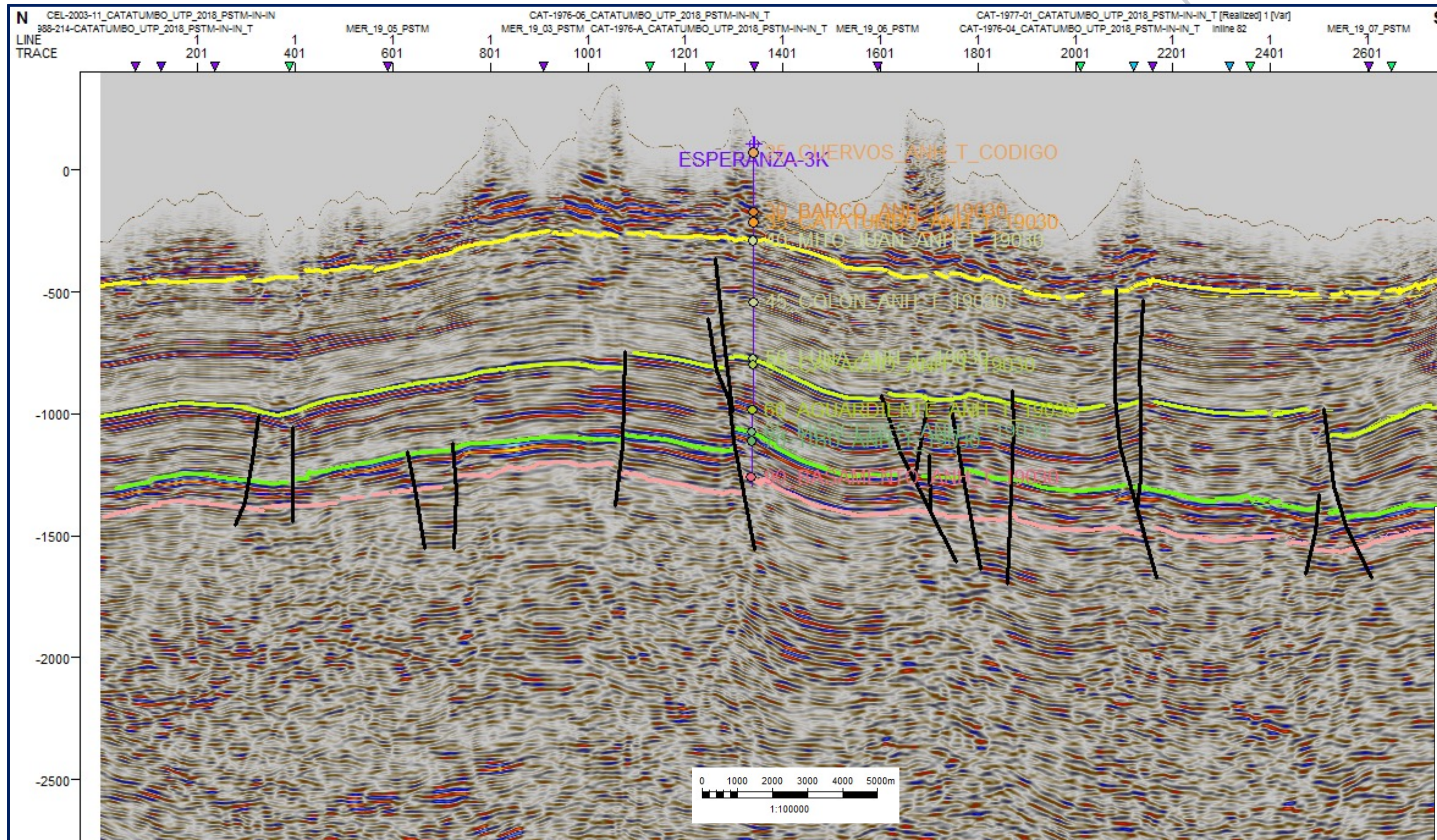


Seismic Lines: MER-19-04

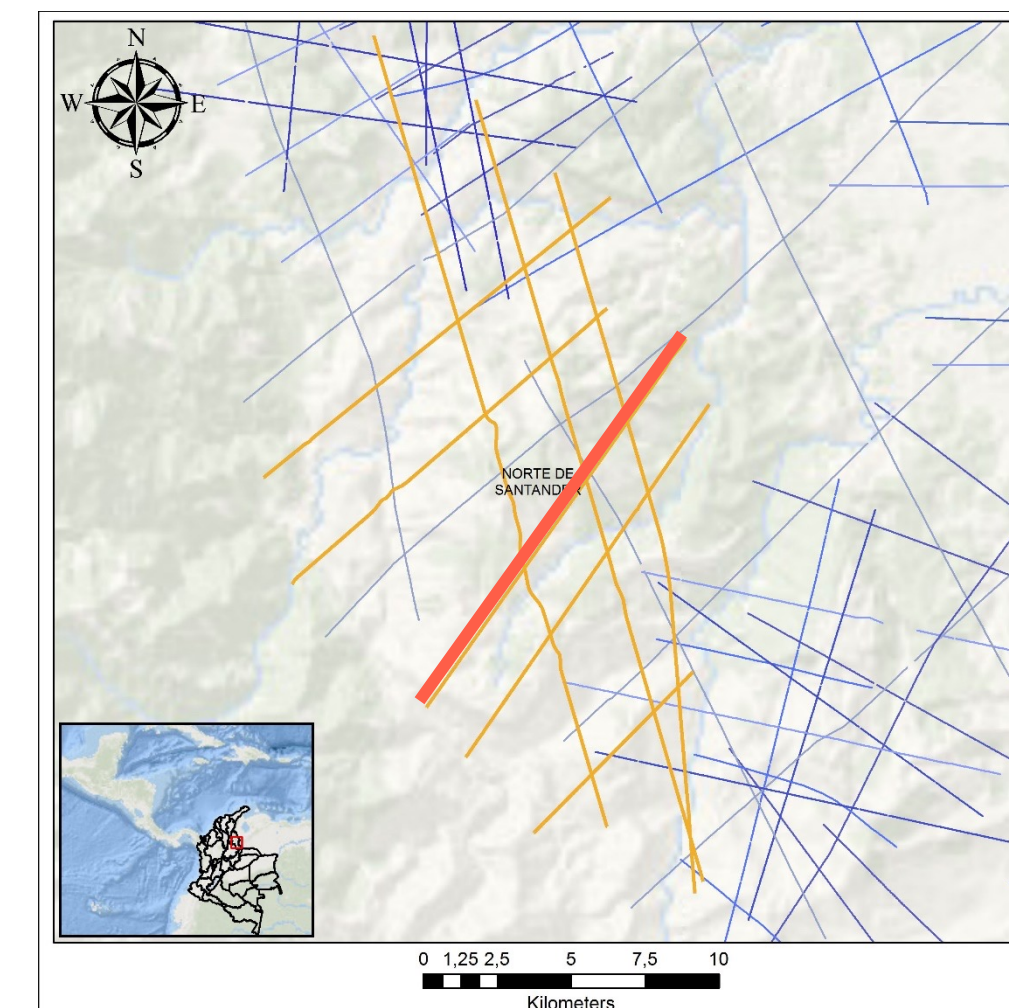
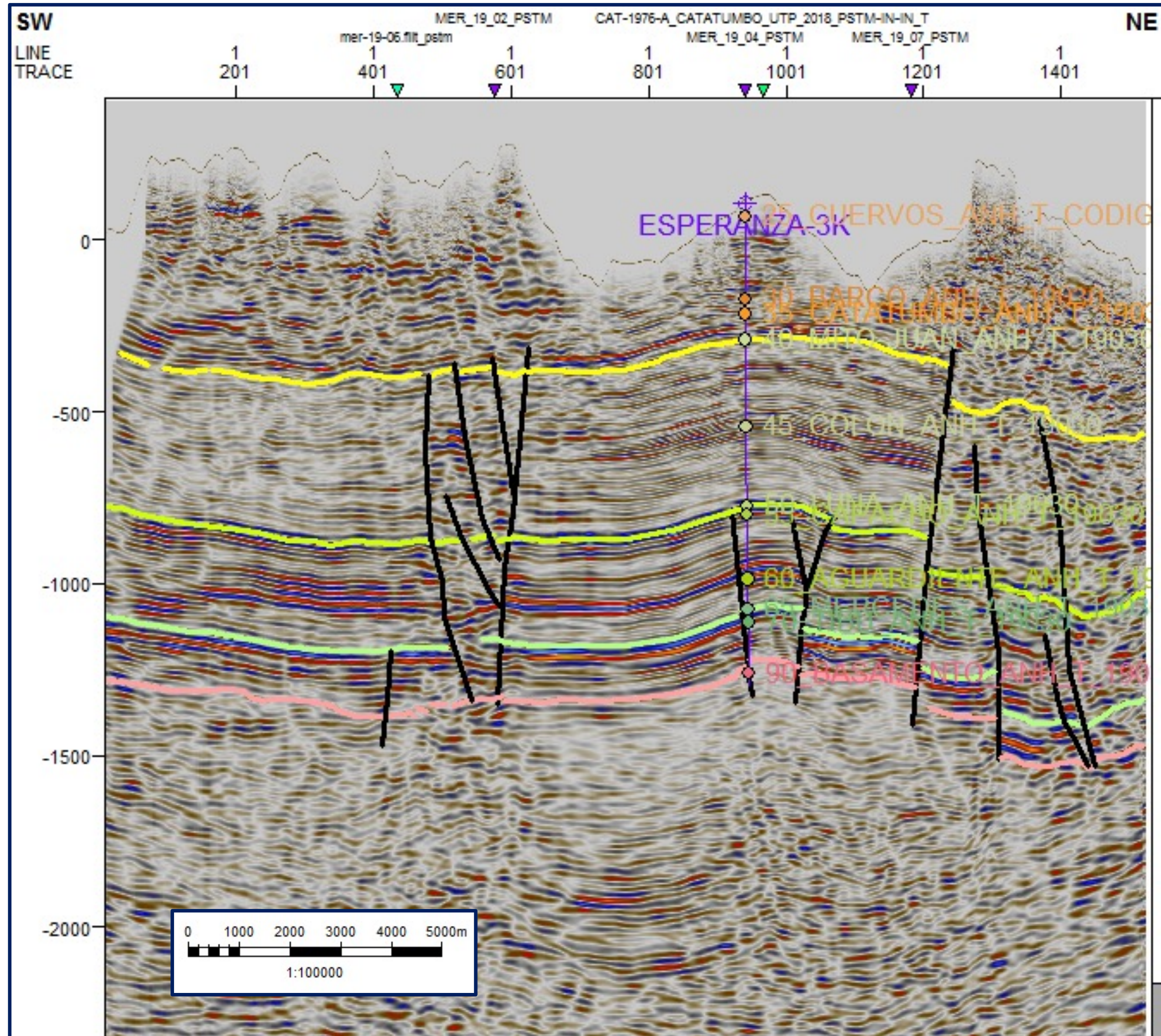


SEISMIC INTERPRETATION

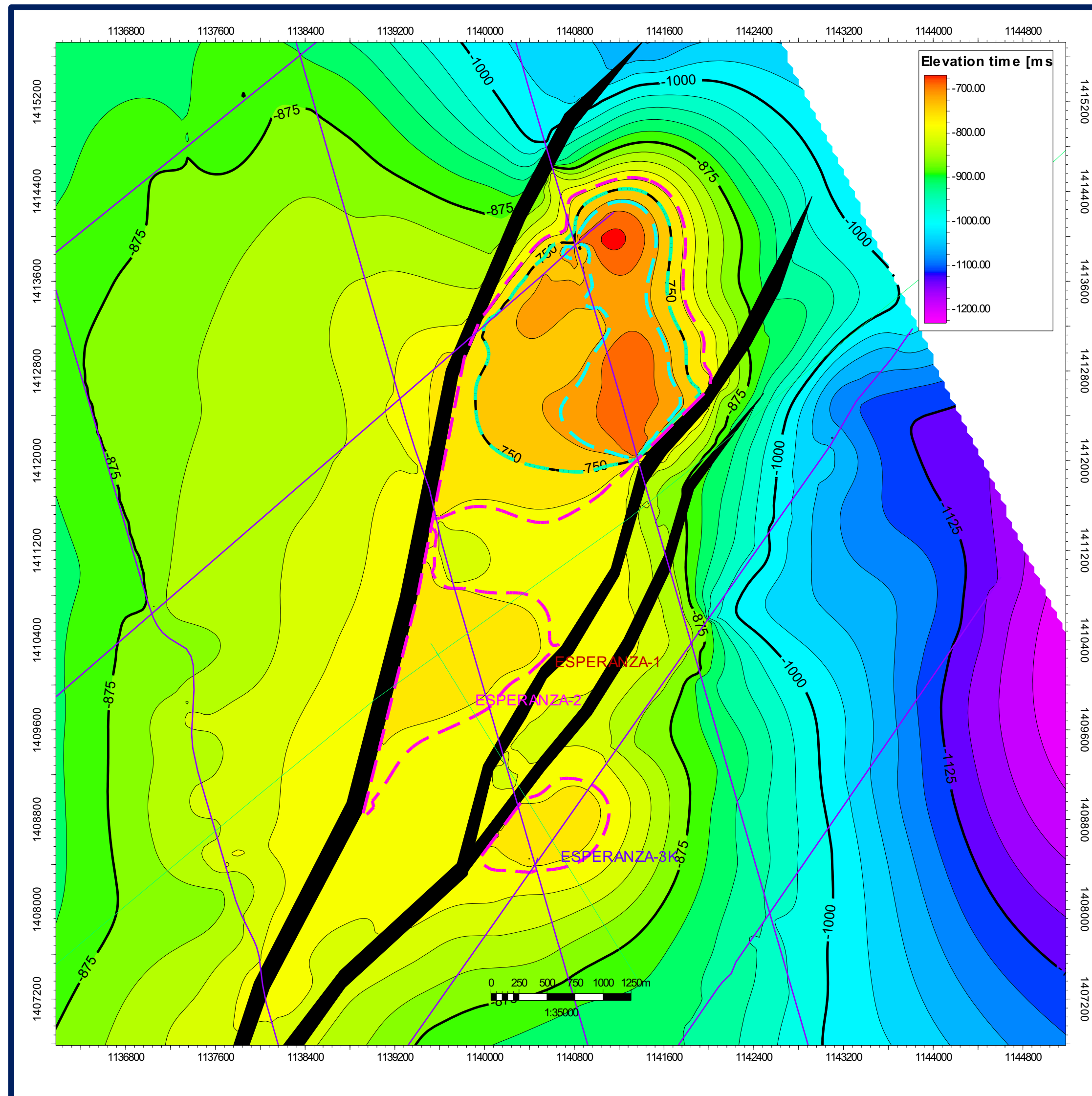
Seismic Interpretation Dip Line



Seismic Interpretation Strike Line



Las Mercedes Structural Map (Top Uribante Group)



Areas

- **High Estimate** 1591 Acres
- **Best Estimate** 840 Acres
- **Low Estimate** 355 Acres

Volumetrics

- Assuming a porosity of 20%, thickness of 340', N/G of 50%, and Sg of 60% the best estimate of **OGIP** is calculated in 93,3 **BCFs**

CONCLUSIONS

- The Catatumbo basin is located at the north-eastern part of Colombia with 7 areas open for incorporation
- The basin has a very **long history of production since 1920s** with 872 wells drilled and 3,874 km of 2D seismic acquired. Twelve **(12) Oil & Gas fields have been discovered** and more than 21 isolated exploratory wells have been drilled
- 11 3D seismic programs and 44 2D seismic programs have been acquired in the history of Catatumbo. The basin has a good infrastructure with 5 oil pipelines including one of the most important pipeline of the country: **Caño Limón - Coveñas**
- At the eastern part of the basin the main reservoirs are located in the Tertiary units: **Carbonera, Mirador, Barco**. Meanwhile at the western part of the basin the main reservoirs are located at Cretaceous units: **La Luna, Aguardiente and Tibú – Mercedes Formations**.
- A **2D seismic survey of 137 Km** distributed in **5 dip** and **3 strike lines** was acquired by the ANH in 2019 based on a map produced using the survey CAT-76 and the test information from the well Esperanza 3K that produced a **non commercial** quantity of **900KCFPD of CO2**
- Las Mercedes 2D have been acquired in order to prove the existence and geometry of a possible giant gas lead at La Esperanza municipality with the reservoir in sandstones of the **Aguardiente Formation**.
- The quality of the seismic is really good with minor imaging issues due to **excessive topographic variations**
- A **best estimate of 93,3 BCFs of gas** have been calculated with the new seismic interpretation using the new Las Mercedes 2019 survey

Thanks

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